The Petroleum Engineer

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• Drilling and Producing
• Refining and Gas Processing
• Oil and Gas Pipelining

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KNOCK-PROOF ENGINE

A significant piece of research that promises far-reaching economies is that on the Texaco Combustion Process, or what is called for short, the Texaco engine. It has to do with combustion knock in engines. This painstaking research project has laid the ground work for the design of an engine that will eliminate combustion knock by mechanical means. Emphasis is placed on "mechanical," for the departure in engine design involves a change in construction.

Laboratory study has revealed the advantages obtained by observing time as a key factor in gasoline engine combustion. By practically eliminating the time lag between the air fuel mixture entering the combustion chamber and the moment it is ignited by the spark plug remarkable results are observed. Air fed into the combustion chamber in a swirling motion at speeds as high as 400 miles an hour, is part of the key operation that produced these results. The fuel is introduced through a spray nozzle into the revolving air stream. As the first part of the mixture to reach the spark is ignited, the remainder of the fuel is fed into the flame front almost as soon as it enters the cylinder, and the products of combustion move instantly along with the air stream. This is the process that eliminates combustion knock, even without the use of octane-rated fuels. Indeed, efficient performance is obtained with fuels of wide boiling range and having no octane-rating. Fuels used included kerosine, jet engine fuel, and domestic furnace oil, as well as modern gasolines. "Engine power tests run at 10 to 1 compression ratio—and two atmospheres super-charge to make the tests even tougher —show that the Texaco engine can get along fine on fuels having a much wider boiling range than present-day gasoline."

If the future fuels for use in this engine "were to be refined on a large scale the refiner would be free to concern himself principally with operating his cat crackers and other tremendously expensive units to produce greater yields at lower cost instead of turning out low-yield high-octane fuels at high manufacturing cost."

This revolutionary development that can be of far-reaching benefit to the petroleum industry and to the general public, to say nothing of its advantages in military, marine, industrial, agricultural, and other transportation applications. It is to be noted, however, that this engine "in still very much in the future. Its impact on our industry will be gradual. The new process will permit the industry to broaden the base of its greatest public service—conservation of our precious natural resources."

A multi-cylinder knock-proof engine such as envisioned by this development marks a signal contribution of the oil industry.—KCS.

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Scanning WASHINGTON'S OIL HORIZON

WASHINGTON—Interior Secretary Chapman has put it squarely up to the industry to carry out the war-oil preparedness program, having given the newly-established Petroleum Administration for Defense (PAD) a free hand to deal with aviation gasoline and other problems.

Chapman had promised industry leaders, as reported here last month, that he would set up a separate oil agency reporting only to him as petroleum administrator, headed by a prominent oil man and staffed with personnel drawn from the industry.

This Chapman did, despite strong pressure from some of his aides who wanted the petroleum unit subordinated to an overall resources administration and insulated from direct contact with the secretary by several layers of departmental staff advisers. These aides to Chapman have died hard. Indeed, they are still maneuvering to put a check-rein on PAD.

After failing to get Ralph K. Davies (Ex-PAW), Chapman went after Bruce K. Brown (Pan-Am Southern) for the job of deputy petroleum administrator. J. R. Parten, Houston oil man who was PAW's transportation director in the last war, was drafted by President Truman to organize the new petroleum administration. Al Frame (Cities Service) was brought in to head up the avgas program.

▸ **Gas Wants Divorce.** One of the first problems to crop up was the demand from the gas industry that a separate agency be set up to handle natural and manufactured gas under the Defense Production Act.

A committee from the American Gas Association, headed by J. French Robinson (East Ohio Gas), has formally recommended that Chapman establish a Gas Administration for Defense (GAD) and a gas industry advisory committee. At present, PAD has jurisdiction over gas. The National Petroleum Council, which has many members interested in gas, has been adviser on both oil and gas.

The argument of the AGA committee was that gas has outgrown its status as an offshoot of the oil industry, that the gas business has nothing in common with oil except where both are produced from the same well and gas—regulated by federal and other agencies—has no relation to problems of the non-utility oil industry.

Apparently, the AGA would have the new agency take over all gas matters from PAD except those instances where gas is produced in connection with oil. This would raise the question of what happens to natural gasoline, LP-Gas, cycling and similar operations which PAD expected to handle.

Chapman has taken the AGA's proposal under advisement, considering it in the light of objections from PAD officials that the petroleum administration can handle both oil and gas adequately as PAW did in the last war.

▸ **PAD's Budget.** Officials of the petroleum administration have worked up a budget of $500,000 to carry PAD until December 31, providing for a staff of about 275. The organization chart calls for divisions to handle production, refining, transportation, natural gas and natural gasoline, supply and distribution, etc. In fact, the new PAD will be virtually a duplicate of the wartime PAW, except that PAD's divisions will have a skeletonized staff that wil be expanded as needed.

▸ **Avgas.** PAD is "making progress" towards its goal of increasing avgas production by 25,000 bbl a day by December 31. A number of specialists have been borrowed from the oil companies to work on the avgas program, channelling components to refiners needing them to complete the finished product. Shortage of tank cars has been a problem.

Arrangements are being made to compensate refiners for any abnormal costs involved. In the meanwhile, Chapman has assured them that he will see that all justifiable costs are paid.

▸ **Materials.** A deal is being worked out with the National Production Authority (Commerce Department) so that PAD can issue priorities orders for materials needed by oil companies supplying the military. For example, a million five-gallon cans will be needed to package lubricating oils needed by the military by December 31. Refiners can present these priorities orders to can manufacturers and get first delivery, ahead of anyone else (except the holders of similar priorities orders).

▸ **Steel.** The NPA is whetting its knife to prune the estimated steel requirements for oil and gas, totaling 11,650,000 tons for 1951 or about 17 per cent above this year, which were compiled for the Interior Department by the petroleum council. NPA has been slow in setting up machinery to allocate steel to the various industries but PAD still expects to get the job of regulating the distribution and use of steel within the petroleum industry.

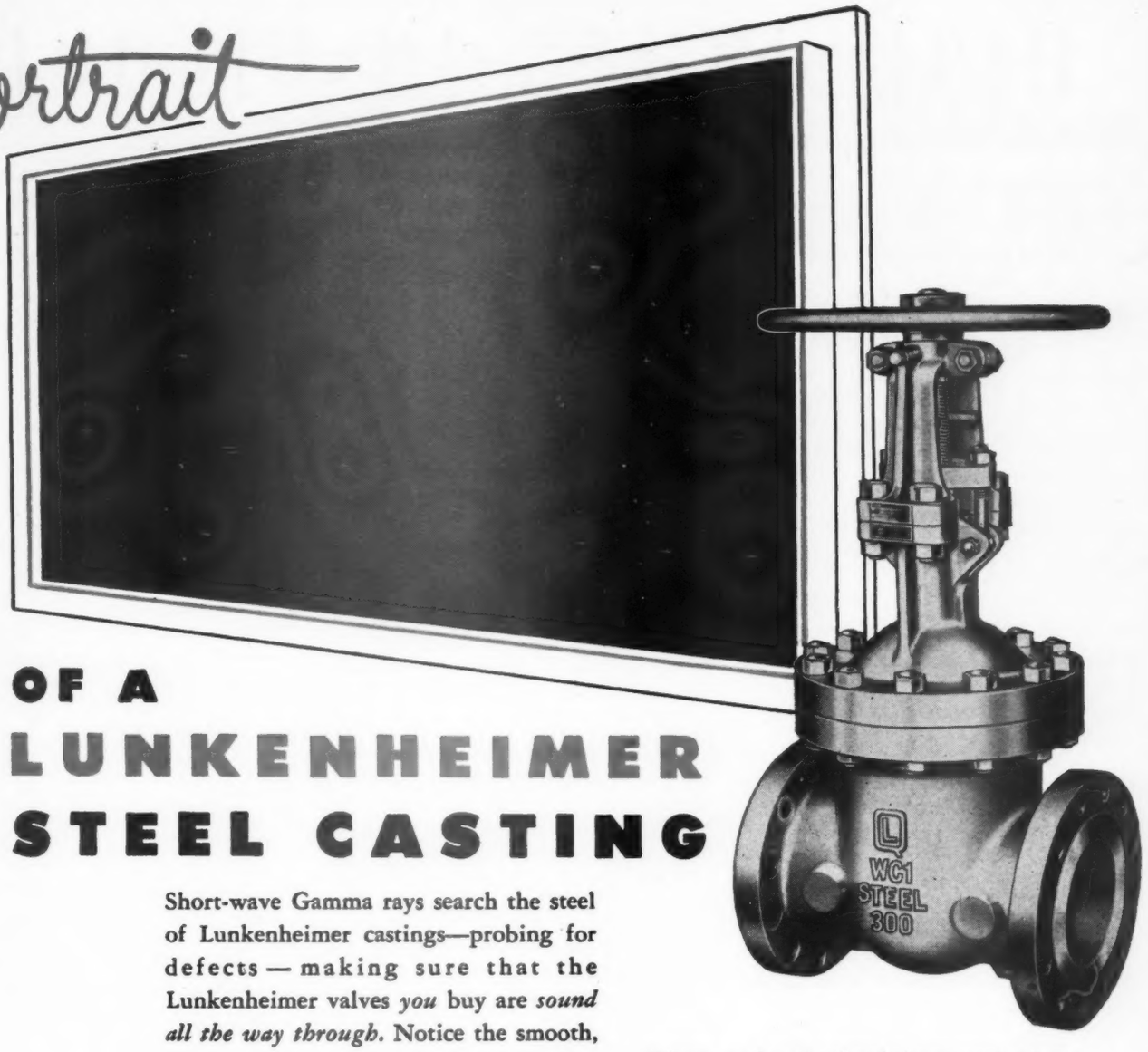
Meanwhile, Chapman still has under consideration the IPAA's proposal that a conference be called to work out a voluntary steel allocation program aimed at providing steel for current operations, particularly the needs of the spot buyers of tubular goods. Participating would be representatives of oil producers, steel mills and distributors of oil field materials.

▸ **Tankers.** The tanker situation is easing after charters went as high as 75 per cent above USMC rates, with opening of the Trans-Arabian Pipeline soon likely to provide further relief by releasing about 70 tankers. ECA is now holding the line on tanker rates at not more than 49 per cent above USMC rates for single voyages, 10 per cent for consecutive voyages over six months and 5 per cent over 12 months. ECA is also considering dropping its requirement that at least 50 per cent of Marshall Plan cargoes must move in U. S. flag vessels.

▸ **Fuels Study.** Chairman O'Mahoney (D, Wyoming) of the Senate Interior Committee has scheduled hearings to begin the latter part of November under the Myers Resolution to develop a national policy on fuels. Objective is to get the views of management and labor, as well as government officials. Questions will be directed to the reserves, demands and best utilization of oil, gas, coal and other sources of energy (except atomic). Meanwhile, oil leaders still regard the investigation as a possible step toward "end use" controls on oil and gas.

▸ **Tidelands.** Texas and Louisiana officials may still entertain hopes of salvaging something in the way of controlling development of submerged lands off their coasts but most of the operators seem inclined to accept the Supreme Court's denial of the rehearing petitions as the final word (unless Congress enacts a quitclaim resolution which is considered unlikely). So, there will be renewed efforts to obtain enactment of some sort of interim bill for operating the tidelands when Congress returns November 27. Meanwhile, Interior Department is still hopeful of working out a stipulation, similar to that with California.

portrait



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HIGHLIGHTS IN OILDOM

Jennings Asks U. S. Aid. B. Brewster Jennings, president, Socony-Vacuum Oil Company has urged that the government assist the nation's oil companies in expanding for wartime needs. Speaking before the Texas Mid-Continent Oil and Gas Association, Jennings is the first man to call on the government for more aid to the oil industry. He asserted that the oil industry needs more than ordinary peacetime economic stimuli to be ready to meet the demands of sudden and total war. He continued, "An adequate defense must include the coordination of the industrial plant with the military effort. The country which does it most effectively will be the strongest."

Steel Industry to Expand. Secretary of Commerce Charles Sawyer has made public the figures given him by the American Iron and Steel Institute, which show that the steel industry plans to expand its annual capacity by the end of 1952 to a total of 109,963,000 net tons. This represents an increase of 9,400,000 net tons over its July 1, 1950 capacity. In addition Sawyer said, the industry plans to increase its annual blast furnace capacity during the same period by 1,734,000 net tons to a total of 73,378,000 net tons.

Oil Industry Prepared: Jones. Speaking before a luncheon of the Executives Club of Chicago, Illinois, W. Alton Jones, chairman of the board of the American Petroleum Institute, stated the American oil industry is better prepared today than at any time in its past to meet any national emergency. During World War II, the oil industry provided for war and civilian needs, Jones stated, and "today, five years after the end of that war, domestic capacity to produce and refine oil has been increased 27 per cent, proved crude oil reserves have been increased 24 per cent, and refining capacity 21 per cent."

Students Guests of Sunray. Twelve Oklahoma high school boys were "oil men for a day" at Sunray Oil Corporation offices and refineries recently as a part of the company's Oil Progress Week activities. Senior high students at Duncan, Comanche, Allen, and Tulsa were selected by their respective high school principles to spend the day with Sunray executives and department heads on an eight hour tour of oil activities.

Search for Hidden Oil. Scientists who comprise the Texas Petroleum Research Committee are working on a project, which if successful should add some 15 billion barrels of oil to our known reserves. Authorities in the oil industry have long thought that only about half the oil known to be in Texas pools is recovered and unless recovery methods are improved the other 15 billion barrels believed to be in the wells will remain under the ground. Scientists at the University of Texas and A & M College aided by the Railroad Commission, are at work on the project. Gibb Gilchrist, chancellor at A&M, said that the possibilities are known to exist because in the Permian basin of West Texas alone are 3 to 5 billion barrels of crude oil trapped in limestone and dolomite formations that can not be produced by present methods.

Oil Firms Dividends Up. An analysis of dividends paid by 48 leading oil companies in the third quarter of this year shows that the trend is toward higher payments. Of the 48 analyzed for the third quarter, 17 made higher payments than in the same period last year, 27 held the payments at the same rate, and 4 decreased their payments. Total payments made by these companies in the third quarter were 21 per cent higher than in the same period last year, the survey revealed. Four companies made dividend payments in the third quarter this year that did not declare one year ago. Completion of most post-war projects was thought to be the reason for higher dividends.

U. S. Loan To Aid Mexican Oil. Mexican officials have been very emphatic in their denial that a prospective $150,000,000 loan will help the Mexican government's oil monopoly. They fail to admit, however, that the loan will free a similar amount of money for furthering the nation's government oil monopoly, Pemex. Terms of the loan clearly rule out any help for the development of oil and gas, and the Mexican government will not be able to use any part of the fund that does not have the approval of the Export-Import Bank, which granted the loan. Mexico sought the loan originally for oil development, but big oil companies, still smarting over Mexico's seizure of their oil prospects in the 30's opposed it. The loan was made to pay for work on highways, railways, communications, etc.

Fuel Oil Supply Seen Adequate. Most of the Midwestern fuel oil suppliers feel now that, barring a global war, they will be able to meet the winter season's demand for domestic fuel oil. Some companies, however, fear spot shortages and periods of transportation difficulty, but no periods of widespread continuing shortages. In the Middle West stocks are now 8.4 per cent above a year ago and will climb higher if the weather continues warm. Middle West stocks of residual fuel oil supplies are 10 per cent above this time last year, but nationally they continue to lag behind last year.

Urge Avgas Output Increase. The oil industry is being urged by PAD to increase its output of aviation gasoline by 25,000 bbl a day before the end of the year. Production averaged 137,000 bbl daily in July, latest Bureau of Mines figures.

Oil for Korean Reds. A former Soviet officer, Lieutenant Colonel Kyril Kalinov, in an article written for *The Reporter*, tells how the Russians got oil to Korea to fuel the recent attack on the South Koreans. He said the Russians constructed a small refinery near Wonsan, which could refine some 100,000 tons a year. Another refinery was installed underground near Lake Tien Chih in the northeast. The latter, according to Kalinov, was intended to refine oil from bituminous schist. The process was a variant of the thermo-catalyzing method developed by Houdry. Kalinov said this secret refinery could supply some 125,000 tons of 80-octane gasoline a year. "To be prepared for any eventuality," Kalinov continues, "we bought gasoline from the Anglo-Dutch companies and planned a reserve of 100,000 tons."

U. S. Oil Reserves Seen Halting Russia. This nation's "overwhelming superiority" in oil reserves will cause Russia to delay an all-out war, is the opinion of Walter S. Hallanan, chairman of the National Petroleum Council. Speaking at a dinner, observing Oil Progress Week, Hallanan said oil reserves of the U. S. are 6 times those of Russia and her satillites, and production is 7 times greater. Hallanan stated that hypothetical oil reserves could not count in the event of war, but rather the refineries would be more important. So far as is known, he added, none of the Russian refineries would be out of bombing range.

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National Petroleum Situation

H. J. STRUTH*

Residual Stocks Subnormal. Stocks of residual fuel oils at the close of September were decidedly sub-normal. Historical data reveal the fact that stocks at the beginning of the winter season should comprise at least 21.7 per cent of the ensuing seasonal demand. Demand this winter will probably aggregate 310,000,000 bbl, which would call for opening stocks of at least 67,200,000 bbl. Actual stocks on September 30 were about 42,500,000 bbl, or 37 per cent below normal working levels. Current stocks amount to only 13.7 per cent of the prospective demand. Stock accumulations this year amounted to only 600,000 bbl, whereas normal accumulations between April and September have averaged about 16,000,000 bbl. Stock accumulations last year amounted to 8,900,000 bbl.

Supply Overtaking Demand. Higher allowables and increased refinery operations, as well as increased imports, have eased the oil supply situation. Supply of all oils in September exceeded demand to the extent of about 10,000,000 bbl. Cumulative supply through September was 9 per cent above last year, while demand was 11 per cent greater. With the exception of residual fuel oils, stocks of major refined products and crude oil on September 30 had attained reasonably sound working levels. At present and projected production and refining schedules, it is likely that further substantial increases in stocks will be realized before the heavy winter demand season gets under way. Distillate stocks are within striking distance of normal working levels, and there appears to be ample assurance of adequate supplies this winter. The stumbling block is residual fuel oil; higher imports may be the only solution to this problem.

*Petroleum Economist.

Peak Refinery Operations. Refinery runs in September reached a new peak of 6,021,000 bbl daily, compared with a daily average a year ago of 5,427,000 bbl. Still runs in the first 9 months of this year were 5 per cent above last year, and averaged about 5,593,000 bbl daily. Refinery operations at the close of September were at 90.1 per cent of capacity.

Natural Gasoline Stimulus. Natural gasoline production in the first 9 months of this year was 15 per cent above last year. This branch of the industry has been given a new stimulus through the new-found utilization of propanes for internal combustion motors. While the availability of this product will be a gradual development, it is expected to impart new life to the natural gasoline business. This is also expected to focus greater attention upon gas waste.

Comparative Statistics, September, 1950

*All figures are computed on a Bureau of Mines' Basis**

	Sept. 1950Ⓟ	August 1950Ⓟ	Sept. 1949	This Year to dateⓅ	Last Year to date	Per cent change
Total supply, all oils	217,667	216,567	180,164	1,792,334	1,649,850	+ 9
Daily average	7,255	6,986	6,005	6,565	6,043	
Total demand, all oils	207,575	215,709	185,104	1,821,091	1,673,793	+11
Daily average	6,919	6,958	6,170	6,671	5,996	
Change in stocks	+10,092	+858	—4,940	—28,757	+13,057	
Crude supply	194,300	193,350	159,434	1,574,251	1,484,963	+ 6
Daily average	6,476	6,237	5,314	5,766	5,439	
Crude demand	190,650	196,900	168,330	1,585,407	1,489,901	+ 6
Daily average	6,355	6,352	5,611	5,807	5,458	
Crude stocks	241,500	237,850	251,689	241,500	251,689	— 4
Days supply	38	37	45	38	45	
Natural gasoline production	14,550	15,200	13,259	130,516	113,352	+15
Daily average	485	490	441	478	415	
Motor fuel production	86,800	93,000 r	80,310	750,398	715,358	+ 5
Daily average	2,893	3,000	2,677	2,749	2,620	
Gasoline yield, per cent	42.8	44.0	43.7	43.4	43.9	— 0.5
Motor fuel demand	86,900	95,900 r	83,373	755,622	714,366	+ 6
Daily average	2,896	3,094	2,779	2,768	2,617	
Motor fuel stocks	105,200	105,300	102,052	105,200	102,052	+ 3
Days supply	36	34	37	36	37	
Fuel oil production	81,275	70,610	63,346	604,171	564,409	+ 7
Daily average	2,709	2,278	2,111	2,213	2,067	
Fuel oil demand	79,190	76,230	63,694	705,764	605,768	+16
Daily average	2,639	2,343	2,123	2,585	2,219	
Fuel oil stocks	120,150	109,450	150,330	120,150	150,330	—20
Days supply	46	47	71	46	71	
Refinery still runs	180,650	184,150	162,812	1,526,901	1,450,446	+ 5
Daily average	6,021	5,940	5,427	5,593	5,313	
Stocks, all oils	574,362	564,270	618,800	574,362	618,800	— 7
Days supply	83	81	100	83	100	

Current Crude Oil Prices

U. S. average	$2.58	Louisiana	$2.62
Texas	2.61	Arkansas	2.43
California	2.42	New Mexico	2.40
Oklahoma	2.62	Mississippi	2.23
Kansas	2.62	Illinois	2.76
		Other states	2.60

Basic crude prices:

Oklahoma-Kansas (36 gr.)	$2.57
Texas Gulf Coast (36 gr.)	2.80
East Texas	2.65
West Texas (36 gr.)	2.44
California Signal Hill (26 gr.)	2.31
Pennsylvania, Bradford	4.00

Drilling and Production Statistics

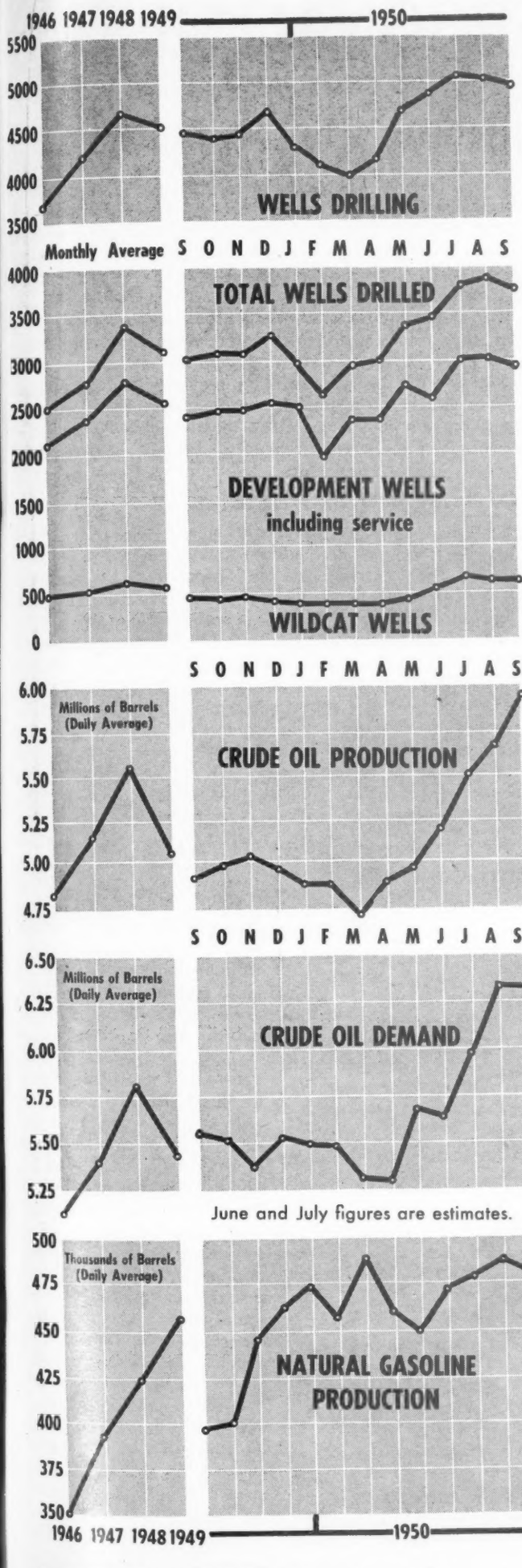
	Sept. 1950	August 1950	Sept. 1949	This Year to date	Last Year to date	Per cent change
Wells drilling	5,045	5,175	4,465	5,045	4,465	+13
Total wells drilled	3,844	3,941	3,298	31,416	28,702	+ 9
Development wells	3,027	3,140	2,596	25,020	22,717	+10
Oil	1,973	2,051	1,730	16,950	15,318	+11
Gas	235	260	249	1,946	2,032	— 4
Dry	819	829	617	6,124	5,367	+14
Per cent dry	27.1	26.4	23.8	24.5	23.6	+ 0.9
Service wells	80	76	91	603	898	—33
Wildcat wells	737	725	611	5,793	5,087	+14
Oil	107	118	85	883	793	+11
Gas	36	11	23	171	143	+20
Dry	594	596	503	4,739	4,151	+14
Per cent dry	80.6	82.2	82.6	81.8	81.8	0

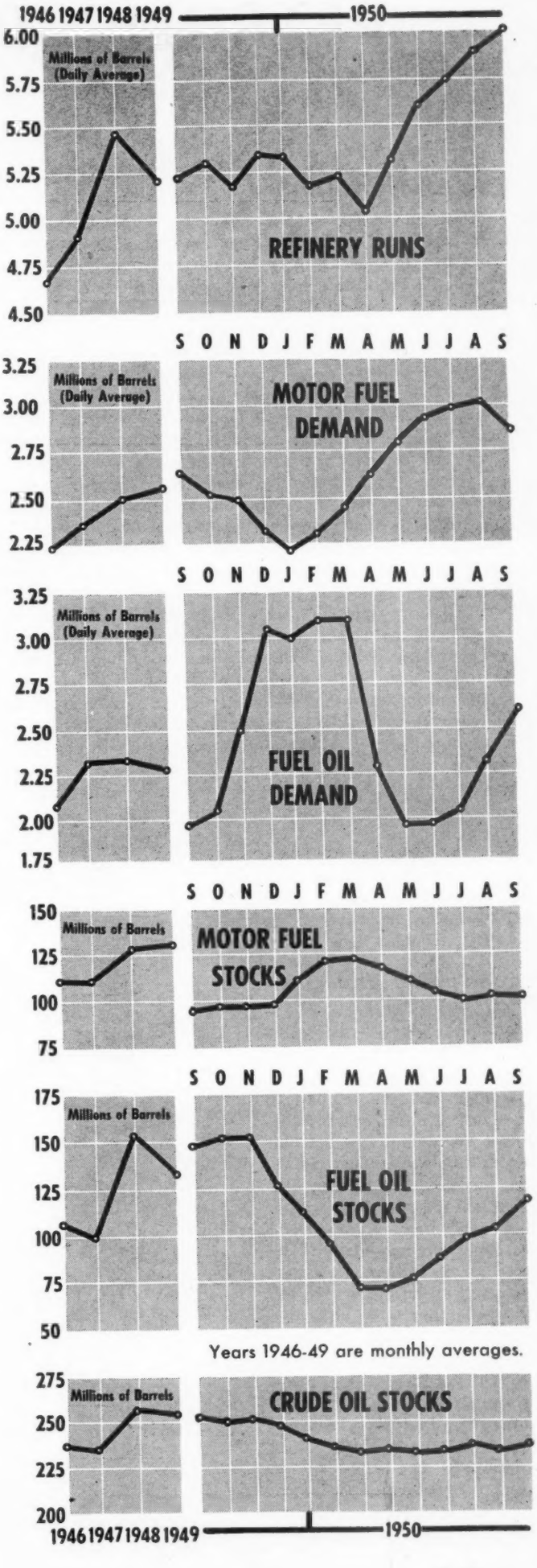
By States

Wells drilled (excl. service)	3,764	3,865	3,207	30,813	27,804	+11
Arkansas	39	34	30	303	245	+24
California	164	174	222	1,358	1,921	—29
Illinois	271	315	257	2,109	1,902	+11
Kansas	302	324	273	2,693	2,395	+12
Louisiana	210	235	247	1,834	1,750	+ 5
Mississippi	26	28	25	241	257	— 6
New Mexico	47	67	36	465	360	+29
Oklahoma	410	483	334	3,944	3,117	+27
Texas	1,475	1,411	1,117	12,248	10,364	+18
Other states	820	794	666	5,618	5,493	+ 2
Wildcats drilled	737	725	611	5,793	5,087	+14
Arkanssas	7	12	9	83	52	+60
California	38	49	33	315	372	—15
Illinois	59	67	55	493	361	+37
Kansas	93	71	55	563	390	+44
Louisiana	21	29	27	205	241	—15
Mississippi	7	11	9	96	81	+19
New Mexico	8	8	8	58	61	— 5
Oklahoma	79	74	54	646	594	+ 9
Texas	306	271	243	2,417	2,201	+10
Other states	119	133	118	917	734	+25
Daily crude production	5,960	5,737	4,940	5,284	5,031	+ 5
Arkansas	88	88	78	86	82	+ 5
California	921	908	898	880	925	+ 5
Illinois	176	176	184	172	176	— 2
Kansas	318	326	270	298	278	+ 7
Louisiana	590	581	507	561	514	+ 9
Mississippi	110	114	100	105	106	— 1
New Mexico	140	138	127	132	131	+ 1
Oklahoma	492	490	404	439	413	+ 6
Texas	2,715	2,487	1,979	2,203	2,027	+ 9
Wyoming	174	174	137	162	128	+27
Other states	236	255	256	246	251	— 2

* Unless otherwise stated all figures represent thousands of barrels. ‡ Total demand, including exports. * Includes domestic production and imports. Ⓟ–Preliminary. r–Revised.

Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.


1946 1947 1948 1949
1950
WELLS DRILLING
Monthly Average
S O N D J F M A M J J A S
TOTAL WELLS DRILLED
DEVELOPMENT WELLS
including service
WILDCAT WELLS
Millions of Barrels
(Daily Average)
CRUDE OIL PRODUCTION
CRUDE OIL DEMAND
June and July figures are estimates.
Thousands of Barrels
(Daily Average)
NATURAL GASOLINE
PRODUCTION


1946 1947 1948 1949
1950
Millions of Barrels
(Daily Average)
REFINERY RUNS
S O N D J F M A M J J A S
MOTOR FUEL
DEMAND
FUEL OIL
DEMAND
Millions of Barrels
MOTOR FUEL
STOCKS
FUEL OIL
STOCKS
Years 1946-49 are monthly averages.
CRUDE OIL STOCKS

PETROLIC PERSONALITIES

DICK SNEDDON

The Chief Welcomer

Many moons have passed since the Great Chief of the Petrolic People elected to counsel with his children in the Land of Plenty Sunshine. And feverish excitement again prevails as the young braves slaughter fatted calves; eager squaws whip up enormous messes of pemmican; and the tribal fathers engage in frequent and prolonged palaver. All this in preparation for another astonishing infiltration. Witch doctors are deep in cogitation, dreaming up spectacular demonstrations for the visiting delegates, and the City of Angels is literally jelled with powwowing committees, counsellors, and just people, putting out terrifically to the end that the good reputation of the New West may be carried clean and unsullied through the rigors of a hectic week. Heading all the multifarious and multitudinous hosting groups is that completely personable being, Clarence Beesemyer, executive vice president of General Petroleum Corporation, and one of the oil industry's best loved people. He began his career in petroleum as a roustabout with the A. F. Gilmore Company, on wells situated in what are now fashionable residential districts of the city. He had risen to the presidency of the Gilmore Company when in 1945 it was taken over by the disciples of Pegasus, and in the new organization too he was quickly given top recognition. Clarence Beesemyer is a friendly, likable sort of a chap who obviously enjoys being well known and highly regarded by a great many people in the west. In his leisure moments he is an enthusiastic member of the Flintridge Riding Club and sits a saddle like one to the manner born. We have long regarded him as one of the industry's best public relations assets and we can think of none better equipped to welcome the delegates to the API Convention.

Equestrian Exercises

Horseback riding seems to be a popular species of exercise with western petroleum executives. There are quite a number who are reputed to be first class equestrians. That, incidentally, is a talent we have always vastly envied in anyone, for despite our best effort, we and saddle horses have remained strangely incompatible. The first time, with much grunting and groaning, we heaved our reluctant torso aboard a pinto or a cayuse or something, we had hardly arrived in the saddle when some strange disturbance took place immediately underneath, and we were catapulted out and up in a beautiful half gaynor and double backward two that stopped with dramatic and painful suddenness at ground level. For some 30 years after that we were not on speaking terms with *equus* or any of his kind. But we finally tried it again. This time, the horse waited until we were seated, and then turning around with a look of absolute scorn on his face, grabbed the loose section of our jodhpurs in his strong teeth and yanked us back down to the solid earth in a gangling, loose-limbed heap. Now, when we feel the urge to indulge in equestrian adventure, we simply dash out to Griffith Park, pay out a dime for a ticket, and leap lightly on the back of a solid dapple grey. And if we do say it ourself, there are few kids in our class when it comes to spearing the gold rings with a neatly hooked digit, as we dash round and round to the tune of the Beer Barrel Polka.

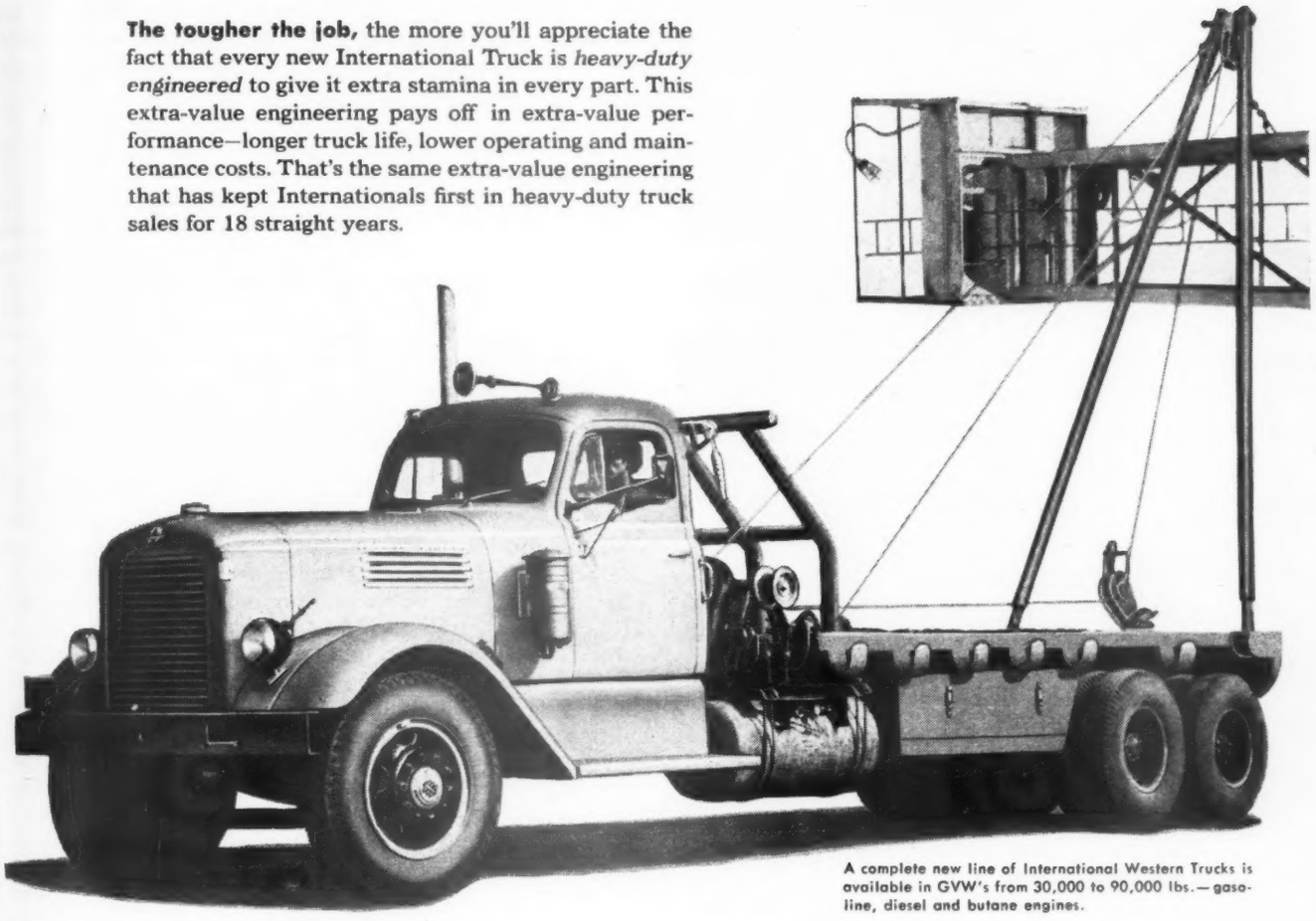
Of Horsemen and Housing

Among the petrolic luminaries on the Beesemyer defrosting panel we note that other Flintridge horseman and all around good citizen, Earle M. Jorgensen, of the steel company of the same name. Earle is a happy, healthy, fine looking chap who never permits convention to interfere with his natural bent for making friends and influencing people. He always addresses his intimates as "kid", and his own obvious satisfaction with life and people generally is as infectious as a yawn. We well remember spending an evening as his guest at the Flintridge Club some time ago, along with a flock of Nineteeners, and a delightful evening it was. On that occasion, although he was everywhere making sure that everyone had a grand time, there was nothing either obtrusive or condescending about the performance. He is just naturally the right sort of people, and just naturally does what the right sort of people are expected to do. We have a hunch, indeed, that even as a member of the API housing committee he will continue to engender good cheer—a mighty difficult thing to do when you are trying to crowd 6000 delegates into a metropolitan center that is already uncomfortably over-crowded. Just how difficult it is to satisfy the housing demands of some individuals is demonstrated in the case of the chap who moved into Los Angeles some time ago, searched high and low for a residence, and was just about to give up when he found a big old unoccupied mansion out in a quiet rural district. No one seemed to be able to tell him who was the owner or give him any other pertinent information about the place, so he simply moved in and settled down. Five years later he appeared before the housing commission demanding to know who was the

Heavy-Duty Engineered

FOR RUGGED OIL FIELD WORK

The tougher the job, the more you'll appreciate the fact that every new International Truck is *heavy-duty engineered* to give it extra stamina in every part. This extra-value engineering pays off in extra-value performance—longer truck life, lower operating and maintenance costs. That's the same extra-value engineering that has kept Internationals first in heavy-duty truck sales for 18 straight years.



A complete new line of International Western Trucks is available in GVW's from 30,000 to 90,000 lbs.—gasoline, diesel and butane engines.

Plus a new kind of comfort and ease of handling

The new Comfo-Vision Cab is the "roomiest cab on the road." There's real comfort in the "posturized" cushions, fully adjustable seats, and controlled ventilation.

One-piece, curved Sweepsight windshield minimizes blind spots, provides road-commanding, full front visibility.

New Super-steering . . . the all-new steering system is engineered for more positive control from a more comfortable position. Wide-tread front axle and shorter wheelbase provide the shortest *practical* turning circle. You get maximum maneuverability to ease you out of the tight spots.

There are 87 basic models, thousands of specialized variations, in the great new International line—with a gross vehicle weight range from 4,200 to 90,000 pounds. Get all the facts about all the features. See your nearest International Truck Dealer or Branch, *soon*.

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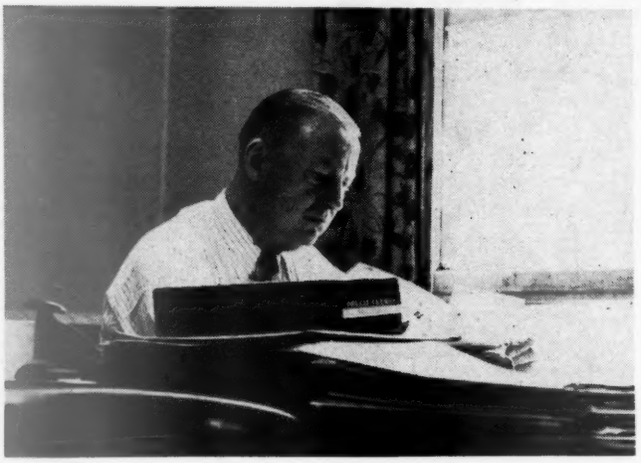
INTERNATIONAL TRUCKS

INTERNATIONAL HARVESTER COMPANY CHICAGO

the owner of the house in which he was living. After hearing his strange story, the chairman expressed surprise that, having lived in the place rent free for five years, he should now jeopardize a very lovely situation by trying to find the landlord. "But I've got to find him," expostulated the tenant, "the roof is leaking."



E. V. Perkins, who is in charge of *The Petroleum Engineer's* Chicago office, is shown here deep in industry. Perk claims he is operating at peak something or other.

A Derrick Floor Dandy

Heading the entertainment committee of the host group is that highly entertaining individual, Frank Morgan, vice president of Richfield Oil Corporation, who ever since we can remember has been a prominent and popular figure in western oil. Frank is an elegant sort of chap, always sartorially correct, fully equipped with all the social graces, yet quite at home either in the tap room or on the derrick floor. He has had a wealth of experience and adventure in the oil business, is an unusually interesting conversationalist, and is the proprietor of a *basso profundo* that has added decisiveness to many a wavering quartet. Besides his manifold business responsibilities, he is vice president and a director of the Petroleum Club of Los Angeles, where his deft handling of the spotted tiles and his uncanny intuition have made him vastly feared by less daring searchers after the five multiples. He is also a long time member of the Wildcats and has often added luster to the already scintillating productions of Bill Geis, the oil man's Eugene O'Neill. There are altogether about 250 committeemen dedicated to the development of a good time for the delegates to the API convention, and the cross section shown here is a pretty fair average sample. They are all good fellows, so if you happen to be overcome by the California ultra-violet, can't find the way back to your room, or don't know whether to bet into a one-card draw, just ask the nearest committeeman —he'll tell you exactly what to do.

A Horticultural Wildcat

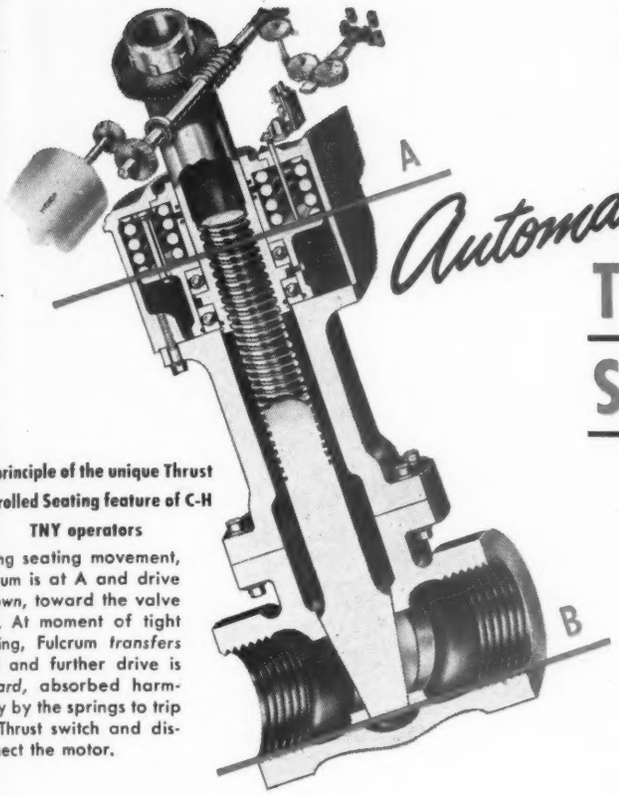
Also listed among those who will help the visiting delegates to feel at home in the strange atmosphere of California is the ubiquitous Bankline and Norwalk prexy, L. L. "Red" Aubert. Here is one of the busiest men in western oil, yet never too busy to do his bit for a worthy cause. What with looking after the building of a new refinery up Bakersfield way, exercising offices in a raft of petroleum organizations and associations, training race horses, playing dominoes, and gardening, his waking hours are pretty thoroughly chewed up. It might be remarked that he is a genuine son of the Golden State. Actually, he had his origin in San Francisco, a sizable bailiwick that is contiguous to the extreme northern boundary of Los Angeles and is famous for its bridgework. After looking around a bit, Red enrolled at Stanford University, whence he emerged in 1922 with an A.B. in geology, a Brunton compass, and a stout determination to do something with them. Not too long thereafter he began making his mark in the petroleum industry. By 1926 he was general superintendent for General Petroleum, and five years later was president of both the Bankline and Norwalk companies. Red is an excellent mixer and has been so active in public life, both socially and industrially, that his friends are legion. He is a member of the important API executive and financial committees, and is also one of the wildest wildcats on the Wildcat Committee of the Western Oil and Gas Association that will be in charge of entertainment at the Convention. All of this no doubt keeps him boisterously busy for the convention duration, but come the end of the grand fracas, he will steal off to the quietude of his garden where for a while he will dilly among the dahlias or perhaps even rest on his laurels. Gardening, he contends, is a fascinating pursuit, in support of which he recites the story of a horticultural acquaintance who goes in for cross breeding and always names his new varieties after prominent local people. Not long ago he developed an aspidestra with a wide yellow streak down its back and two city councilmen promptly disappeared.

The Yellow Tiger Holds Open House

Wandered down with a few hundred others to see Web Wilson and his sundry cohorts ensconced in their fantoosh (OK! What if it isn't in the dictionary?) new quarters on San Pedro Street, in the bustling bailiwick of Los Angeles. It is a great spread all right—the offices are so modern, the world won't catch up until about 1960. When we first walked in past a good looking receptionist, we thought we had made a mistake and gone into the Biltmore Flower Shop —the whole layout was ablaze with blossoms. And what a layout! We'd be willing to work for nothing—well, almost nothing—in a place like that. Bill, the estimable scion of the House of Wilson who is given to wearing luminescent sport shirts looked highly pleased with developments. And well he might. If environment has any stimulative effect on the mental processes, he should produce worthwhile ideas one a minute henceforth, for his office is as modern as the day after tomorrow. Once, confidentially, we found ourself alone in it, so we sat down behind the big desk, tried to look fierce, and was in the middle of giving what for to an imaginary employee when a young lady walked in. We blushed furiously and pretended to be singing but could tell that she still seriously doubted our sanity. We ducked out of there pronto, took a look at Web's quarters, and By's —By Landis, that is—and then went outside. There we greeted Cammie and a lot of other interesting people, including Bill Sefton, the lad who built the new place. Bill will be remembered as the pole vaulter who tied with Lee Meadows for the world's record some years ago. We used to bowl with his dad in the Union Oil league. That was in the good old days when we could bend in the middle. Anyway, before we get too far off the subject, we are wishing Web, Bill, By, and all the gang the very most of the very best, and as for all the nice new facilities and surroundings —well, it couldn't happen to nicer people.

☆ ☆ ☆

This happened after World War III, when atomic bombs had killed every last human being. Much later, when the dust and debris had settled, a couple of monkeys came out of their cave and solemnly surveyed the desolate landscape. After gazing for some time, the small monkey turned to her friend and said, "Well, honey, shall we start the whole darn thing over again?"

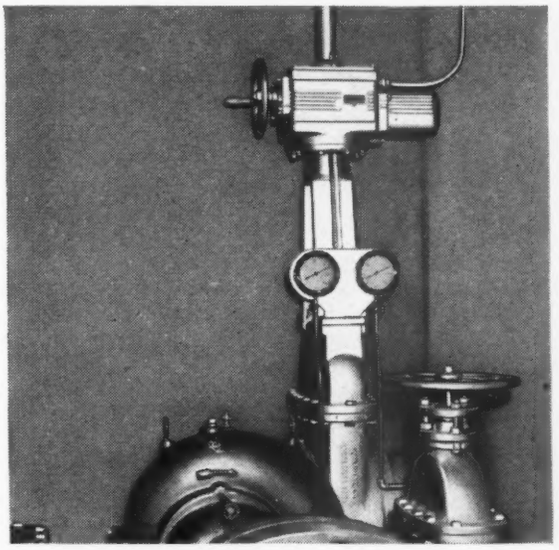


The principle of the unique Thrust Controlled Seating feature of C-H TNY operators

During seating movement, Fulcrum is at A and drive is down, toward the valve seat. At moment of tight seating, Fulcrum *transfers* to B and further drive is *upward*, absorbed harmlessly by the springs to trip the Thrust switch and disconnect the motor.

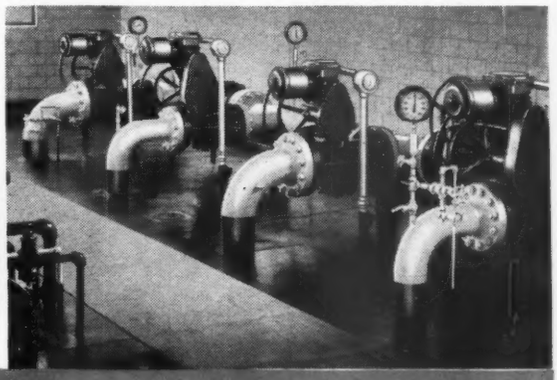
Automatic Valve Operation?

Thrust Control makes it Safe and Accurate, too!



Exclusive Cutler-Hammer Thrust Control Valve Operators from few pounds thrust up to 80 TONS can be applied to any gate valves in the petroleum industry.

For valves which do not seat, such as the plug type valves, C-H B2 automatic declutching valve operators act swiftly and stop instantly.

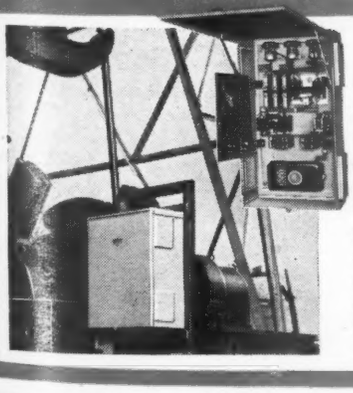


IN THE petroleum industry, automatic, instant and swift motorized valve operation is an economic "must." Distance, difficulty, frequency of operation and danger are factors that urge such a step.

But the problem is also one of *accurate* and *safe* seating . . . as assured by the Thrust Control principle employed exclusively in Cutler-Hammer Valve Operators. The motor *positively* drives the valve disc home. During the driving period, the fulcrum is established at the yoke nut by heavy steel springs which exactly balance *tight seat pressure*. Therefore, at the very instant of desired tight seating, the driving fulcrum transfers to the seat of the valve, hence any further drive is into the yoke nut, against the heavy springs which harmlessly absorb motor drift. The movement of the yoke nut against the springs trips the *THRUST* switch to disconnect the motor. The amazing part is that the same degree of tight seating is maintained no matter how much valve parts may expand or contract. No other valve operator has or can have this direct *THRUST* controlled feature. No other valve operator can be as safe and sure and accurate. CUTLER-HAMMER, Inc., 1459 St. Paul Avenue, Milwaukee 1, Wisconsin.

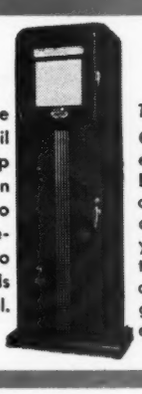
CUTLER-HAMMER
VALVE CONTROL
C-H

OTHER CUTLER-HAMMER PRODUCTS FOR THE OIL AND GAS INDUSTRY



Long-lasting control that "schedules" oil well pumping

This Cutler-Hammer Motor Control Device built to the rigid requirements of tough oil country service automatically starts pump going and shuts it down in synchronization with oil well capacity or in conformity to operating schedule. You can set up any sequence of day and night operation, set it to skip certain days. Bulletin 9589D-21 tells all about this amazing pumping control. Send for free copy.



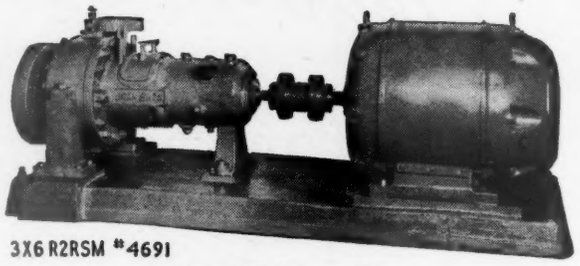
Know what you are buying, selling, giving away

These "gas counting" instruments tell you accurately

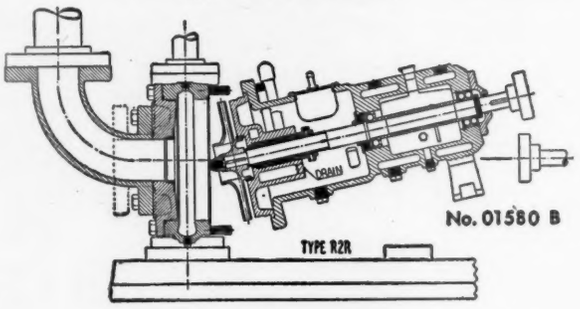
Cutler-Hammer Calorimeters . . . standard wherever gas is bought or sold—actually count the B. t. u.'s per cubic foot of the gas you are sending or receiving. Accurate within 1%. They also write a continuous 24-hour a day permanent record so you know at all times exactly what is going through your piping system . . . for accurate accounting and billing, and for accurate control of gas heating value. Free booklet "Where Experience Counts" tells all about C-H B. t. u. Control.

DEAN BROTHERS PUMPS INC.

Type R2R Centrifugal Process Pumps



Type R2R Process Pump



Type R2R Process Pump

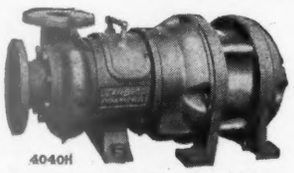
DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

OPERATING RANGE; Type R2R, Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed.

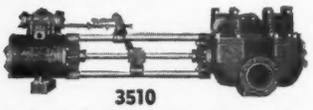
Capacities: 50 to 2000 Gallons per minute. Heads: Up to 400'. Speeds: 900 RPM to 4000 RPM.

BUILDERS OF OUTSTANDING PUMPS SINCE 1869

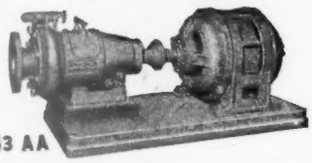
CENTRIFUGAL and RECIPROCATING PUMPS



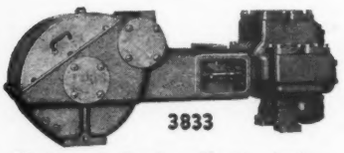
Close Coupled Centrifugal Pump



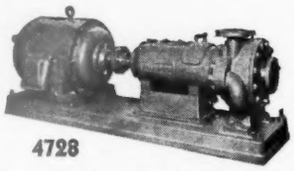
Horizontal, Single Style, Double Acting, Piston Type, Close Clearance Pump. Designed to handle volatile liquids



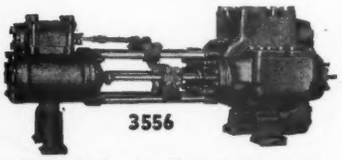
Pedestal Mounted Centrifugal Pump



Horizontal, Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump



Double Pedestal Bearing Centrifugal Pump



Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

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Representatives in Principal Cities

MEETINGS

Nov. 9-10—SAE, Fuels and Lubricants Meeting, The Mayo, Tulsa, Okla.

Nov. 10—California Natural Gasoline Assn, Annual Fall Meeting, Ambassador Hotel, Los Angeles, Calif.

Nov. 11-13—Oil Industry Information Committee, Biltmore Hotel, Los Angeles, Calif.

Nov. 13-14—American Petroleum Institute, Lubrication Committee, Biltmore Hotel, Los Angeles, Calif.

Nov. 13-16—American Petroleum Institute, Annual Meeting Biltmore Hotel and Ambassador Hotel, Los Angeles, Calif.

Nov. 26-28—Tennessee Oil Men's Association, Peabody Hotel, Memphis, Tenn.

Nov. 27-29—American Standards Association, Waldorf-Astoria Hotel, New York, N. Y.

Nov. 26-Dec. 1—American Society of Mechanical Engineers, Hotel Statler, New York, N. Y.

Nov. 27-Dec. 2—Power and Mechanical Engineering, 19th Exposition, Grand Central Palace, New York, N. Y.

Dec. 1-2—American Institute of Mining and Metallurgical Engineers, Texas Local Sections, Texas Technological College, Lubbock, Texas.

Dec. 3-6—American Institute of Chemical Engineers, Annual Meeting, Neil House, Columbus, Ohio.

Dec. 6—New Mexico Oil and Gas Association, La Fonda Hotel, Santa Fe, New Mexico.

Dec. 8—Natural Gasoline Association of America, Regional Meeting, Herring Hotel, Amarillo, Texas.

Dec. 26-31—American Assn for the Advancement of Science, Annual Meeting, Hotel Statler, Cleveland, Ohio.

1951

Jan. 8-9—Kansas Oil Men's Assn. Annual Convention, Lassen Hotel (tentative), Wichita, Kansas.

Jan. 8-12—Society of Automotive Engineers Annual Meeting and Engineering Display, Hotel Book-Cadillac, Detroit, Michigan.

Jan. 9-10—Pipe Line Contractors Association, Shamrock Hotel, Houston, Texas.

Jan. 18-20—Southwestern Legal Foundation, Second Annual Institute on Oil and Gas Law and Taxation, Southwestern Legal Center, Dallas, Texas.

Jan. 26—Southern Gas Association, Accident Prevention Round Table, Mobile, Alabama.

Feb. 23—NGAA—Regional Meeting, Settles Hotel, Big Spring, Texas.

March 5-9—ASTM, Spring Meeting and Committee Week, Cincinnati, Ohio.

March 7-9—API Division of Production, Southwestern District Meeting, Hotel Beaumont, Beaumont, Texas.

March 8-9—Indiana Independent Petroleum Association, Spring Convention and Refiners and Suppliers Exhibit, Hotel Severin, Indianapolis, Ind.

March 13-17—National Association of Corrosion Engineers, Annual Conference and Exhibition, Statler Hotel, New York, N. Y.

March 16-18—American Society of Lubrication Engineers, Annual Convention and Lubrication Show, Bellevue-Stratford Hotel, Philadelphia, Pa.

March 21-23—API, Mid-Continent District, Herring Hotel, Amarillo, Texas.

April 2-4—Western Petroleum Refiners Association, Annual Meeting, Plaza Hotel, San Antonio, Texas.

(Continued on Page A-20)

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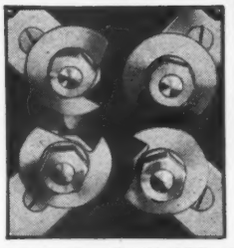

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(Continued from Page A-18)

April 3-5—API, Division of Production, Eastern District Meeting, Deshler-Wallick Hotel, Columbus, Ohio.

April 10-12—Southwestern Gas Measurement Short Course, University of Oklahoma, Norman, Oklahoma.

April 16-18—American Society of Lubrication Engineers, Annual Convention and Lubrication Show, Bellevue-Stratford Hotel, Philadelphia, Pa.

April 18-20—National Petroleum Assn, Hotel Cleveland, Cleveland, Ohio.

April 19-20—API, Rocky Mountain District, Spring Meeting, Gladstone Hotel, Casper, Wyoming.

April 23-25. Southern Gas Association, Buena Vista and Edgewater Gulf Hotels, Biloxi, Mississippi.

April 25-27—Natural Gasoline Assn of America, Annual Convention, Mayo Hotel, Tulsa, Oklahoma.

April 29-May 4—American Gas Assn, Industrial and Commercial Gas Section, Industrial Gas School, William Penn Hotel, Pittsburgh, Pa.

April 30-May 2—American Geophysical Union, Annual Meeting, National Academy of Sciences, Washington, D. C.

April 30-May 3—American Petroleum Institute, Division of Refining, Mid-Year Meeting, Mayo Hotel, Tulsa, Oklahoma.

May 6-9—Liquefied Petroleum Gas Assn, Annual Convention and Trade Show, Stevens Hotel, Chicago, Illinois.

May 10-11—API, Division of Production, Pacific Coast District, Spring Meeting, Biltmore Hotel, Los Angeles, Calif.

May 13-16—AIChE, Regional Meeting, Hotel Muehlebach, Kansas City, Mo.

May 14-16—AGA, Operating Section, Production and Chemical Conference, Hotel New Yorker, New York, N. Y.

May 28-June 6—Third World Petroleum Congress, Kurhaus, Scheveningen, Holland.

June 16-20—Canadian Gas Assn, Bigwin Inn, Lake of Bays, Ontario, Canada.

June 18-22—American Society for Testing Materials, Annual Meeting, Atlantic City, N. J.

Sept. 12-14—National Petroleum Association, Hotel Traymore, Atlantic City, N. J.

Oct. 15-18—American Gas Association, Annual Convention, St. Louis, Missouri.

Oct. 14-20—Oil Progress Week.

Nov. 5-8—API, Annual Meeting, Palmer House, Chicago, Ill.

NOMADS TO MEET

New York, N. Y., Chapter, First Monday of the Month, Louis Sherry's, New York, N. Y. Sec. Russ V. McIntire, 11 West 42nd Street, New York 18, New York.

Houston Chapter, Second Monday of the Month, Ye Ole College Inn, Houston, Texas. Sec. Harry E. Estes, P. O. Box 9321, Houston 11, Texas.

Los Angeles Chapter, Second Wednesday of the Month, Jonathan Club, Los Angeles, Calif. Sec. John W. Rife, 5905 Pacific Blvd., Huntington Park, Calif.

Tulsa Chapter, Third Wednesday of the Month, Hotel Tulsa, Tulsa, Okla. Sec. G. W. Davidson, Jr., Box 1188, Tulsa, Oklahoma.

Dallas Chapter, Dallas, Texas, First Monday of the Month. Sec. C. J. Berlin, Box 2968, Dallas, Texas.

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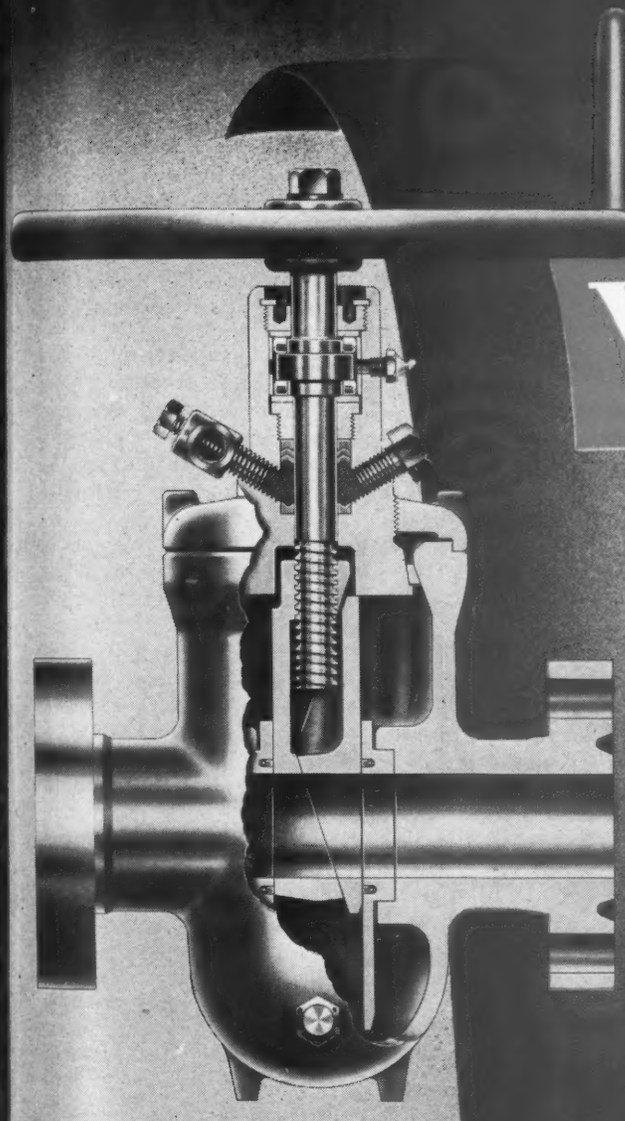

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LETTERS TO THE EDITORS

Well Spacing

To The Petroleum Engineer:

I have read with interest H. H. Kaveler's articles, Parts 1 and 2, entitled: 'MORE WELLS—MORE OIL', which appeared in your issue of last month.

His rate-time curves on full log paper show slopes of one to one. This means Volumetric Control in my language. Why does he neglect the rate-time curves with the slope of three to one? Such a slope means Capillary Control.

When I worked with the Gypsy Oil Company (now Gulf Oil Company) in Tulsa we had hundreds of rate-time curves with the slope of three to one. Cutler's work, to which Kaveler refers at length, is based upon observations in Capillary Control. Figure 4 in U. S. Bureau of Mines Bulletin 228 shows the computed slope of 3.009 for a theoretically correct slope of 3.000. Cutler did well with his field data in that case. His other figures are not so perfect. However, they certainly hover around three to one; some below, and some above. One figure shows a slope of two to three. This was for Ventura Avenue in California, a case of Volumetric Control. Had his data been as good as Kaveler's the slope would have been one to one.

In so far as Kaveler's discussion pertains to Volumetric Control I agree with him fully. Close spacing will not increase recovery. It will only increase the rate of recovery. This, of course, is a matter of importance to some operators. In saying that close spacing will not increase recovery I am assuming a blanket formation, non-lenticular and unfaulted, and I imagine he does the same.

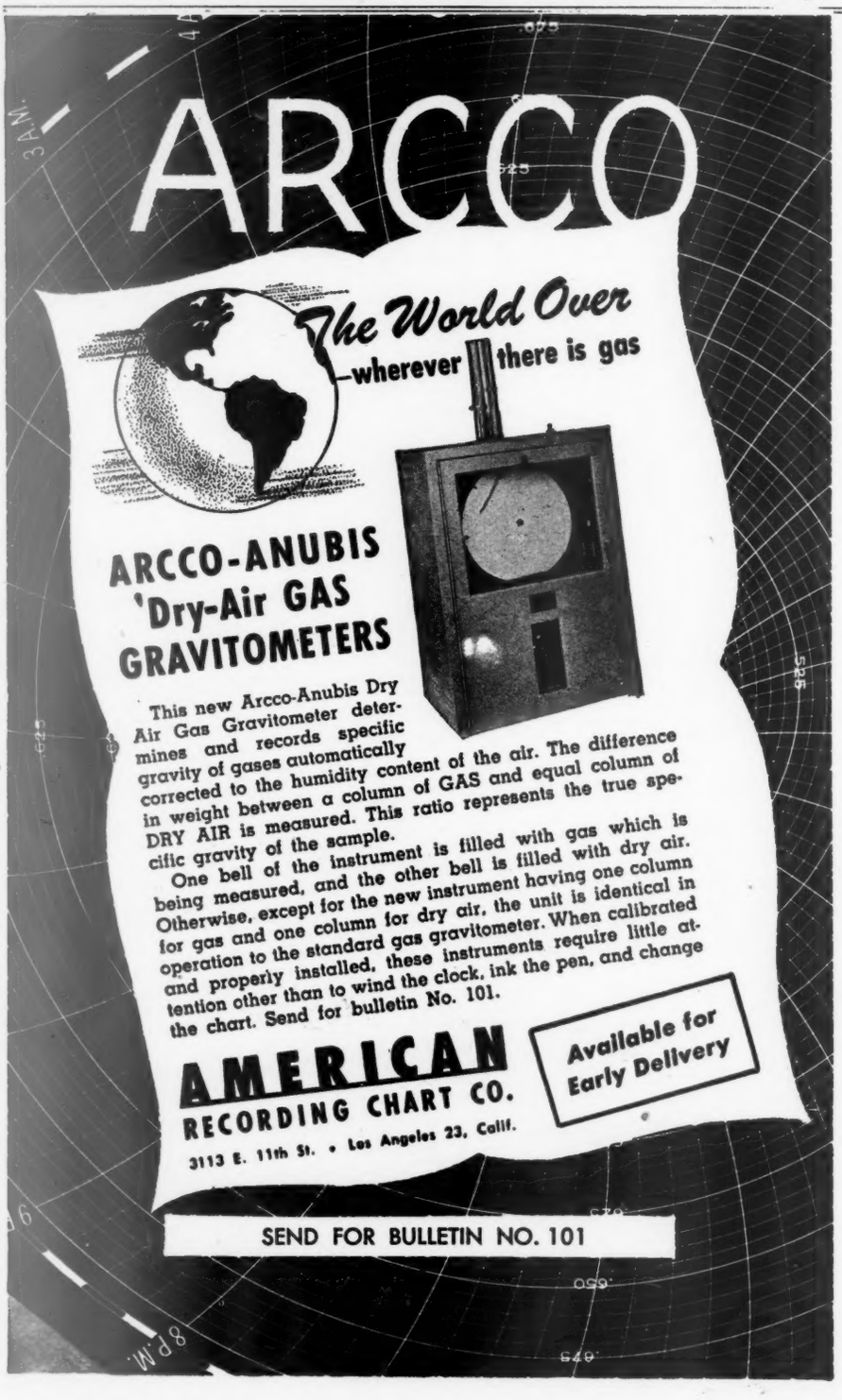
But in Capillary Control closer spacing does increase recovery. Each well has its own restricted drainage area surrounding it. Furthermore, recovery diminishes outward from the well to exactly zero at the perimeter of the drainage area.

In Volumetric Control we can be assured that oil not produced at one well will be produced at another one higher on structure, again if we assume the absence of lenticularity and faulting between such wells. Contrarily, in Capillary Control any oil not produced at one well will never be produced at another, regardless of location, no lenticularity and no faulting. According to the manner in which we develop our fields the percentage recovery of reservoir content in Capillary Control is less than half that recovered in Volumetric Control. It is not remarkable that we often obtain more oil by secondary recovery than we had by primary recovery in fields of Capillary Control.

Unfortunately for Kaveler his articles will not close the argument about recovery on spacing. Those who work with wells of Capillary Control—regardless of whether they recognize the Control as such by name—will continue to oppose him, and rightfully so. Why should they not base their opinions on their findings in the field?

Cutler, Beal and Lewis, and Swigart all worked with wells of Capillary Control when they were with the U. S. Bureau of Mines. Their conclusions must therefore be accepted in the light of such Control. Their writings do not need the qualifications ascribed to them by Kaveler, for they are correct with respect to the particular Control.

There is admittedly strong opposition to the idea of Capillary Control. Most of it lies with the petroleum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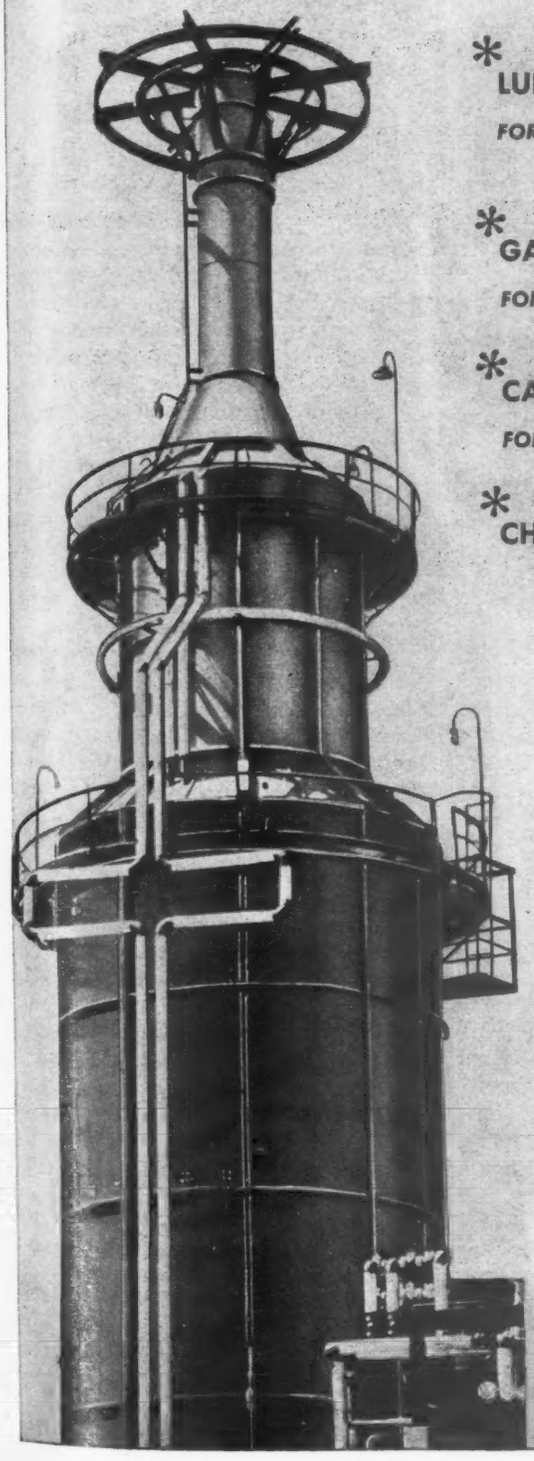

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physicists of major oil companies. I hope Kaveler does not go along with the opposition. These physicists, if of sufficient age, have had twenty-five years to study field experiences; yet they have not done so. They are content with precise experimentation in the laboratories. They sincerely believe their results are applicable in the field. I believe they are, but only so after a field has been classified as to its Control.

The idea of the separate types of reservoirs should not be hard to accept. Volumetric Control means Edgewater Drive, and Capillary Control means Gas-expansion Drive. But of course there is more to the subject than the mere matter of drive. The internal reservoir events are considerably different with the two.

We have now had twenty-five years of discussion relative to the spacing of wells. Cutler published in 1924 the work he did in 1923, and the arguments started soon afterwards. Are we to have twenty-five years more of dissension? If and when the controls are fully accepted we shall eliminate much of the disagreement between petroleum engineers and physicists. I hope to see such acceptance before I enter whatever there is after this interesting life.

It is not only spacing involved in our dissensions. Percentage recovery is one of prominence. Estimates range between ten and ninety per cent. A recognition of the Controls, and the application of their respective principles, will improve this situation.

Recently I have had the privilege of testing new wells in new fields to determine the Control. The results were better than I had expected. You know that wells often have little habits of their own. But the wells I tested were very young. Apparently they had not adopted the ways of debauchery.

But to get back to Kaveler's papers. Let us eliminate the alibis with reference to Cutler's writing, and say that Kaveler is dead right—for Volumetric Control. He must not spread his findings to all wells and fields. Neither should anyone working with Capillary Control do likewise.

Stanley C. Herold
Glendale, California

To The Petroleum Engineer:

I would appreciate receiving a reprint of your informative article, "Electro-chemical Instrument Records Sulfur Content" as published in the September 1950 issue of *The Petroleum Engineer*, Page C-53. Thank you very much.

J. H. Karchmer
Baytown, Texas

Huntington Beach, 1934.

P 111.61

A Look at the California Oil Industry

RICHARD SNEDDON*

FROM Christian Hill to Cuyama, the way of California petroleum has been long and rocky, and there has been much of interesting incident and episode to add sparkle to an epoch of industrial adventure that has been far from dull. It seems difficult to relate the history of oil development in any area without going into a spasm of verbal acrobatics over the roistering of the swashbuckling element by whom the early industry was at least partly peopled. These rugged, rough-and-tumble indomitables of the first years lend lurid color to the petrolic saga, and no doubt were a very essential part of it. But we incline to the belief that the less demonstrative, more studious men were the ones who really contributed most to immediate substantiality and sustained progress. They it was who calmly analysed situations and opportunities, instituted orderly procedures, and eventually organized and controlled the rampant forces of the new industry.

The men who laid the first foundations of the petroleum industry in California were in the main serious minded people, and mostly they were experts in the business, hailing from the oil fields of Pennsylvania. They were not the sheer, wanton gamblers that some writers would have us believe. Lyman Stewart was an experienced operator before he ever saw California. So was Wallace Hardison, his partner. D. G. Scofield was just 27 years old when he arrived in the west but he was already thoroughly familiar with the drilling and production techniques of his time. C. A. Mentry was famed as a rig builder when he was still in Pennsylvania. And W. E. Youle was a recognized authority on drilling when he obeyed the Horace Greeley injunction and struck out for the blue Pacific.

When they arrived on the Coast, these men didn't just haphazardly punch a lot of holes in the ground and hope for the best. They selected their properties for lease or purchase with the greatest meticulousness by the somewhat crude species of evaluation that then prevailed. Seepages, oil accumulations, simple correlations between surface indications and subsurface conditions, and the experiences of prior operators, all had their bearing on the matter of choice. The operators were proud of their specialized knowledge, and we suspect that many of them never would admit even to themselves that they were gambling. Lyman Stewart, as an example, was an intensely religious man, and didn't believe in gambling. When he drilled a well, he was investing in his own know-how, not simply tossing coins to arrive at decisions.

About the turn of the century, the native and near-native Californians began to assert themselves in the petroleum picture. Men like W. W. Orcutt, Frank Hill, Dick Guiberson, and Bill McLaine, were no longer pupils of the Pennsylvania operators. They had graduated in the school of experience, some of them from good colleges in addition, and they were able

*Pacific Coast Editor.

EXCLUSIVE

not only to conduct their own operations, but also to improve on existing methods. W. W. Orcutt is believed to have instituted the petroleum industry's first geological department. Frank Hill is credited with the introduction of oil well cementing in California. Dick Guiberson was a pioneer manufacturer of drilling equipment. Bill McLaine was one of the early authorities on pipe line construction and operation. There were others, many of them, all substantial contributors to the progress of the industry. Then there were those who sort of dropped in at intervals, like Cy Bell and Lin Little, who came from the east about 1908, bringing with them the first rotary drills, and thereby, probably without being conscious of it at the time, literally revolutionizing the industry.

Since then the story has been one of continuous technical development, and California operators have a proud record of achievement in every phase. Quantitatively, the total production of the state didn't amount to much as compared with the national figure until about 1902 when it totalled 14,356,910 bbl, or 16.17 per cent. By that time the Kern River field was really getting under full steam and showed a yield for the year of 8,988,046 bbl, considerably more than half of the state total. The producing fields then were Ventura, Newhall, Los Angeles-Salt Lake, Summerland, Coalinga, Brea - Olinda, McKittrick, Midway - Sunset, Kern River, and Santa Maria.

Thereafter, the climb was fast until in 1913 the peak production of all time was reached. In that year California produced 90,074,439 bbl of oil, or 40.4 per cent of the national total. Midway-Sunset had then reached the substantial annual total of about 39,000,000 bbl, and Coalinga was doing almost 19,000,000 bbl. Lost Hills-Belridge at the same time hit its all time high with almost 6,000,000 bbl, and Whittier and Coyote were rapidly getting into the picture. The first production from Ventura Avenue showed in the record in 1916. Then followed at one or two year intervals, Montebello, Richfield, Elk Hills, Huntington Beach, Santa Fe Springs, Long Beach, Torrance, Dominguez, Rosecrans, and other basin fields, including Wilmington. At the same time, greater or lesser strikes were being made in the Coastal and Valley areas, among the latter being the prolific Kettleman North Dome. The total California production rose steadily with the discovery of each additional field, with Wilmington eventually becoming the top producer, and Ventura Avenue and Huntington Beach running neck and neck for second place. Meantime the national production had increased tremendously and California's proportion failed to hold up. At the moment of writing, the state produces approximately 913,000 bbl per day, or 15.5 per cent of the national total.

One of the most interesting California discoveries of recent years is Cuyama, about 98 air miles north of Los Angeles, in which Richfield Oil Corporation has been definitely the party of the first part. In the two years since the beginning of active Richfield interest in this area, three separate producing fields have been found. Thirty oil firms have interests in the district, and 354 wells have been drilled, of which 265 have proved to be producers. Richfield alone has drilled 247 wells with 203 producers. The oil is of light gravity and good refining quality. Nearly 12,000,000 bbl have been produced to date. Over 900,000 ft of hole have been drilled in the area, and 700,000 ft of casing has been set in the wells. Richfield has invested $27,600,000 in its Cuyama Valley program up to the present, $15,000,000 in production costs, $9,600,000 for a compressor plant, and $3,000,000 for a pipe line. Wells in the Russell Ranch field average about 3500 ft in depth, require 12 to 18 days to drill, and cost about $60,000 each. In South Cuyama, the average depth is about 4500 ft, wells take two or three weeks to drill, and cost approximately $70,000 each.

In his admirable report on developments in the West Coast area during 1949, Graham B. Moody points out that California set a new record for that year by drilling 588 exploratory wells, and 2,138,501 ft of exploratory hole, a considerable increase over the preceding year. Three new oil fields, 12 new oil pools, 4 new gas pools, and extension of the productive limits of 4 already producing pools, added extensively to available reserves. By far the most exciting of the new developments was South Cuyama, a major field, discovered by Richfield Oil Corporation in its Homan "81-35," on May 4, 1949. This well came in flowing at an initial rate of 4888 bbl a day from the perforated interval, 4095 to 4390 ft. The oil was of 34.2 API gravity and dry. Production was from the Diblee sand (lower middle Miocene), same as the discovery zone in the Russel Ranch field, approximately 4 miles northwest. By the end of 1949 this field had 62 producers, yielding under voluntary curtailment about 7500 barrels a day.

Drilling activities in 1949, according to the Moody report, increased reserves by 166,195,000 bbl from new fields and new pools, and 136,200,000 bbl from extension of previously discovered pools. Since these estimates are studiously conservative, it is safe to assume that actual additions are even more substantial. In any case an increase of 302,395,000 bbl in reserves is a pretty good reward for a year of effort.

During last year, 1723 new oil wells were completed, 82 wells were recompleted, and 139 inactive wells were placed back on production. Wells suspended and wells abandoned were 1027 and 115 respectively, leaving a net increase of 802 in the number of producing wells in the state, bringing the total active wells to 29,295. For 1950 the picture up to the moment is not nearly so pleasing. To September 23, the total new wells was 1324 as compared with 1894 for the like period in 1949, a drop of 570. This is largely due to the scarcity of steel occasioned by the war threat and the consequent tightening of heavy metal supplies. During 1949 lack of demand for crude and the cut in price caused operators to postpone the drilling of a considerable number of development wells. This slacking, according to Graham Moody, was partly taken up by the splurge of exploration.

At the moment of writing, activity in Korea has had a serious effect on drilling in California. Metals, particularly tubing, are just not available and the whole program, including both exploration and development wells, is definitely bogged down. With controls of all sorts in the offing, and increased taxation a certainty, the immediate future of California petroleum is not exactly rosy. There will undoubtedly be representation to Washington for a reasonable allocation of essential metals and it is to be hoped it will meet with some measure of success. After all, the doctrine of preparedness to which we are supposed to be dedicated certainly requires adequate reserves of such a vital war material as petroleum.

The Oil Producers Agency of California lays the responsibility for the present somewhat gloomy picture in the state, partly to the dwindling demand for residual fuel, occasioned by the dieselization of the main transportation media, and the increasing substitution of natural gas for fuel oil in the heavy industries. No doubt all of the things mentioned have their separate influences, but the well demonstrated elasticity of the California petroleum industry justifies the optimistic belief that the prevailing slump is temporary and that as soon as a proper system of allocation is set up, the search for oil in California will continue with unabated zeal. * * *

W. Alton Jones, president, Cities Service Company, and chairman, API Board of Directors, will preside at general sessions and at meetings of API Board of Directors.

Frank M. Porter, president of API, will make the President's Address at the general session Wednesday at 9:30 a.m.

Reese H. Taylor, president, Union Oil Company of California, will speak to a general session Thursday morning. He is a member of the API Board of Directors.

Benjamin F. Fairless, president, United States Steel Corporation, will speak to a general session Thursday that begins at 9:30 a.m.

P 023.1

API to Hold 30th Annual Meeting

Los Angeles will be host November 13 through 16 to members of the American Petroleum Institute for the first time since 1935.

THE American Petroleum Institute will hold its 30th annual meeting in Los Angeles, California, November 13 through 16—the first such meeting on the West Coast since 1941 and the first in Los Angeles in 15 years. Previous West Coast meetings were in San Francisco 9 years ago, and in Los Angeles in 1935.

Thousands of oil and gas men from all sections of the country are expected to attend this annual meeting and participate in the many committee sessions, group meetings, panels, and forums. An interesting program is being arranged, and the meeting itself is expected to be one of the best ever sponsored by the Institute.

A highlight of the annual gathering will be a banquet Wednesday night, November 15, sponsored by West Coast oil men. Planned for 2500 guests at the famous Hollywood Palladium Ball Room, it will be the first API banquet at an annual meeting since 1941. The local committee handling arrangements is headed by Arthur C. Stewart, of Union Oil Company of California.

To accommodate the influx of oil men, the Biltmore and Ambassador Hotels will be used for the heavy schedule of committee and group sessions; and the Biltmore Theatre, adjacent to the Biltmore Hotel, will be used for general sessions.

The two general sessions will be held Wednesday and Thursday morning, November 15 and 16—both getting under way at 9:30 a.m. Both will be presided over by W. Alton Jones, president, Cities Service Company, New York, and chairman of the API Board of Directors.

Frank M. Porter, API president, will address the first general session, Wednesday morning.

Presentation of the API Gold Medal for Distinguished Achievement also will be made Wednesday morning to an as yet unidentified recipient. The gold medal, awarded annually, was presented last year to J. Howard Pew, director and retired president of Sun Oil Company, Philadelphia. Previous recipients were Dr. Charles F. Kettering, the internationally known scientist, in 1948; Dr. William M. Burton, of Cambridge, Massachusetts, former president of Standard Oil Company (Indiana), in 1947; and Henry Ford, the motor magnate, in 1946.

Scheduled to address the second general session, Thursday morning, are Benjamin F. Fairless, president of United States Steel Corporation, New York; and Reese H. Taylor, president of Union Oil Company of California.

Monday, November 13, 1950

GROUP SESSION
Accident Prevention

9:30 AM Biltmore Music Room

Presiding: F. R. McLean, Socony-Vacuum Oil Company, Inc., Detroit, Michigan.

Panel Discussion: "Establishing and Maintaining an Effective Fire-Control and Safety Program."

Panel Members:

J. H. Myers, The Atlantic Refining Company, Philadelphia, Pennsylvania (Leader).

R. W. Black, Esso Standard Oil Company, Linden, New Jersey.

Robert L. Minckler, president, General Petroleum Corporation, will speak at a production session at 2 p.m. Wednesday.

Robert E. Wilson, president, Standard Oil (Indiana), is chairman of the research committee, which meets 12:30 Wednesday.

Fred Farrel Florence, president, Republic National Bank of Dallas, will speak at a production session at 2 p.m. Wednesday.

W. J. Arnold, assistant vice president, Pure Oil Company, will speak at a financial and accounting session at 2 p.m. Tuesday.

R. L. Wheelock, president, Wheelock and Collins, is chairman of the production division's general committee, which meets Tuesday.

C. L. Hightower, United Gas Pipe Line Company, Shreveport, Louisiana.

W. O. Wilson, Standard Oil Company (Indiana), Chicago, Illinois.

J. H. McKenzie, General Petroleum Corporation, Los Angeles, California.

GROUP SESSION

Division of Marketing

2:00 PM Biltmore Ball Room

Presiding: J. Howard Marshall, Ashland Oil and Refining Company, Ashland, Kentucky.

Address:

B. E. Devere, Pathfinders Petroleum Company, Los Angeles, California.

Address:

B. L. Majewski, Deep Rock Oil Corporation, Chicago, Illinois.

Address:

Hon. Oscar L. Chapman, Secretary of the Interior, Washington, District of Columbia.

Tuesday, November 14, 1950

GROUP SESSION

Financial and Accounting

9:30 AM Biltmore Conference Room 1

Presiding: R. G. Rankin, The Texas Company, New York, New York.

Some Observations on Accounting Problems of the Oil Industry. George Wagner, Arthur Anderson and Company, New York, New York.

Treatment of Pension Costs, Including Those of Non-funded Retirement Plans. C. A. Jackson, The Ohio Oil Company, Findlay, Ohio.

Financial and Statistical Disclosure in Annual Reports. Max Lorimore, Union Oil Company of California, Los Angeles, California.

Accounting for Financing by Means of Long-Term Lease. H. Jeffries, Sinclair Oil Corporation, New York, New York.

The Sterling-Dollar Problem. Speaker to be announced.

GROUP SESSION

Division of Marketing

10:00 AM Biltmore Ball Room

Presiding: J. Howard Marshall, Ashland Oil and Refining Company, Ashland, Kentucky.

Report of Division's Nominating Committee. Harry B. Hilts, Empire State Petroleum Assn., Inc., New York, New York, Chairman.

Election of Members of the General Committee of the Division of Marketing.

BOARD OF DIRECTORS

10:00 AM Biltmore Conference Room 3

BOARD OF COUNCILLORS

10:00 AM Biltmore Music Room

To nominate candidates for election as members of the Board of Directors.

GROUP SESSION

Division of Transportation

Pipe-Line Symposium

10:45 AM Ambassador Theatre

Presiding: J. H. Peper, The Buckeye Pipe Line Company, New York, New York.

Developments in External Pipe Coatings and Cathodic Protection Materials. C. L. Goodwin, Portland Pipe Line Corporation, Portland, Maine.

Developments in Internal Pipe Coating Techniques. J. K. Alfred, Shell Pipe Line Corporation, Colorado City, Texas.

Developments in Large-Diameter River-Crossing Construction. F. Hill Sanders, Sun Pipe Line Company, Beaumont, Texas.

Fire Protection

Fire-Training Demonstration

1:00 PM Local Oil Plants

(Sponsored by the Central Committee on Fire Protection)

GROUP SESSION

Financial and Accounting

2:00 PM Biltmore Conference Room 1

Presiding: R. G. Rankin, The Texas Company, New York, New York.

University Education for Business Leadership. Neil H. Jacoby, Dean, School of Business Administration, University of California, Los Angeles, California.

Internal Auditing. Donald P. Jones, Sun Oil Company, Philadelphia, Pennsylvania.

Visual Presentation of Charts and Figures to Executives. W. J. Arnold, The Pure Oil Co., Chicago, Ill.

B of M Alumni

The customary Bureau of Mines Alumni Breakfast, held each year at the annual meeting of the American Petroleum Institute, will be held this year on Wednesday, November 15, in the Biltmore Hotel, Los Angeles.

GROUP SESSION

Lubrication Session

2:00 PM Biltmore Music Room

Presiding: W. M. Murray, Deep Rock Oil Corporation, Chicago, Illinois.

Address: Colonel Benjamin S. Mesick, Chief of Research and Material Branch, of the Research and Development Division, of the Office of Chief of Ordnance, Washington, District of Columbia.

Address: Gustav Egloff, Universal Oil Products Company, Chicago, Illinois.

Address: Captain W. C. Latrobe, Director, Material Development, Standards and Specifications Division, Bureau of Ships, Washington, District of Columbia.

BOARD OF DIRECTORS

2:00 PM Biltmore Conference Room 3

GROUP SESSION

Division of Production

2:00 PM Biltmore Ball Room

Presiding: Paul Andrews, Signal Oil and Gas Co., Los Angeles, California, and George E. Cannon, Humble Oil and Refining Co., Houston, Texas.

Conservation and Property Rights. George Hazlett, of the Law Firm of McAfee, Grossman, Taplin, Hanning, Newcomer, and Hazlett, Cleveland, Ohio.

Presentation of API Certificates of Appreciation. By R. L. Wheelock, Vice President for Production.

Optimum Use of Coring, Electric Logging, and Other Testing Methods in Exploratory Wells. John E. Walstrom, Standard Oil Company of California, San Francisco, California.

Well-Completion Practice. T. A. Huber, G. F. Abendroth, and T. O. Allen, Humble Oil and Refining Company, Houston, Texas.

GROUP SESSION

Division of Transportation

2:00 PM Ambassador Theatre

Presiding: J. H. Peper, The Buckeye Pipe Line Company, New York, New York.

Developments in Automatic Station-Control Techniques. Speaker to be announced.

Mathematical Prediction of Pipe-Line Surge Phenomena. Milton Ludwig and Sidney P. Johnson, Standard Oil Company of California, San Francisco, California.

How API Code 25 Can Be Improved. G. H. Supple, General Petroleum Corpora-

Hines H. Baker, president and director, Humble Oil and Refining Company, will speak at 2 p.m. Wednesday at a production session.

John E. Gosline, Standard of California, as chairman of the nominating committee will give a report at a production session Wednesday, 2 p.m.

John E. Walstrom, well logging consultant for Standard of California, will speak to a group session on production at 2 p.m., Tuesday.

Paul Andrews, Signal Oil and Gas Company, will preside at a production session, Tuesday, 2 p.m.

William E. V. Abraham, vice president, Burmah Oil Company, Ltd., will speak at 2 p.m. Wednesday at a production session.

T. H. Acres, Richfield Oil Corporation, is chairman of the production division's publications committee, which meets Sunday at 2 p.m.

John R. Suman, Standard Oil Company (New Jersey), is chairman of an oil field equipment standardization committee, which meets Wednesday at 9 a.m.

T. V. Moore, Standard Oil Development Company, heads a research committee, which meets 10 a.m. Tuesday.

T. A. Huber, Humble Oil and Refining Company, is co-author of a paper that will be delivered Tuesday at 2 p.m. to a production session.

E. W. Berlin, head of producing department, Standard-Vacuum Oil Company, is chairman of defense services committee, meeting at 10 a.m. Tuesday.

T. O. Allen, Humble Oil and Refining Company, is co-author with T. A. Huber, above, of a paper on "Well Completion Practice."

George Fancher, professor of petroleum engineering, University of Texas, heads a special project committee on permeability meeting at 9 a.m. Monday.

tion, Los Angeles, California, and R. Charles Nicholson, Shell Pipe Line Corporation, Houston, Texas.

GROUP SESSION

Public-Relations Session

8:00 PM Biltmore Ball Room

Presiding: George H. Freyermuth, Standard Oil Company (New Jersey), New York, New York.

Program to be announced.

Wednesday, November 15, 1950

GENERAL SESSION

9:30 AM Biltmore Theatre

Presiding: W. Alton Jones, Cities Service Company, New York, New York.

Report of Board of Councillors and Election of Directors.

President's Address: Frank M. Porter, President, American Petroleum Institute, New York, New York.

Presentation of Gold Medal for Distinguished Achievement.

Response by Recipient.

Address: Speaker to be announced.

GROUP SESSION

Division of Production

2:00 PM Biltmore Ball Room

Presiding: H. H. Kaveler, Phillips Petroleum Company, Bartlesville, Oklahoma, and R. O. Garrett, Arkansas Fuel Oil Company, Shreveport, Louisiana.

California Oil. R. L. Minckler, General Petroleum Corporation, Los Angeles, California.

Percentage Depletion and Intangible Development Costs. Hines H. Baker, Humble Oil and Refining Company, Houston, Texas.

Oil, Gas, and the Banker. Fred F. Florence, Republic National Bank of Dallas, Dallas, Texas.

Oil in the Far East. William E. V. Abraham, The Burmah Oil Company, Limited, London, England.

Report of Division's Nominating Committee. J. E. Gosline, Standard Oil Company of California, San Francisco, California, chairman.

Election of Members of the General Committee of the Division of Production.

GROUP SESSION

Division of Refining

(With Cooperation of the Division of Marketing)

2:00 PM Biltmore Music Room

Presiding: Chester F. Smith, Standard Oil Company (New Jersey), New York, New York.

Synthetics in Defense. James Boyd, Director, U. S. Bureau of Mines, Washington, D. C.

Address: Lawrence R. Hafstad, Atomic Energy Commission, Washington, D. C.

Report of Division's Nominating Committee. G. L. Neely, Standard Oil Company of California, San Francisco, California, Chairman.

Election of Members of the General Committee of the Division of Refining.

GROUP SESSION

Division of Transportation

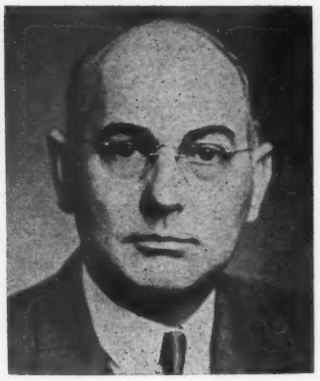
2:00 PM Ambassador Theatre

Presiding: T. E. Swigart, Shell Pipe Line Corporation, Houston, Texas.

Building a Greater America. Major-General Lewis A. Pick, Chief of Engineers, Washington, D. C.

W. M. Holaday, director of laboratories, Socony-Vacuum Oil Company, is chairman of the program committee, refining division, meeting Tuesday 9 a.m.

Chester F. Smith, vice president, Standard Oil (New Jersey), is chairman of the general committee, refining division, meeting at 2 p.m. Tuesday.



John W. Newton, vice president and director, Magnolia Petroleum Company, is chairman of refining division's advisory committee, meeting 4 p.m., Monday.

Ralph B. Clark, Gulf Research and Development Company, is chairman of a refining subcommitee on emission spectroscopy, meeting Saturday 9 a.m.

Presentation of API Certificates of Appreciation. By T. E. Swigart, Vice President for Transportation.

Railroads and National Security. F. G. Gurley, Atchison, Topeka, and Santa Fe Railway, Chicago, Illinois.

Report of Division's Nominating Committee. J. H. Peper, The Buckeye Pipe Line Company, New York, N. Y., Chairman.

Election of Members of the General Committee of the Division of Transportation.

Western Intercity Trucking Operations and Equipment. J. L. S. Snead, Jr., Consolidated Freightways, Inc., Portland, Oregon.

California and Its Natural Resources (sound and color movie, sponsored by the Richfield Oil Corporation and produced under the supervision of the Bureau of Mines).

BOARD OF DIRECTORS

2:00 PM Biltmore Conference Room 3

ANNUAL DINNER

7:30 PM Palladium Ball Room—Hollywood

Program is being arranged by a local banquet committee. Arthur C. Stewart, Union Oil Company of California, Los Angeles, California, Chairman.

Thursday, November 16, 1950

GENERAL SESSION

9:30 AM Biltmore Theatre

Presiding: W. Alton Jones, Cities Service Company, New York, N. Y.

Address: Reese H. Taylor, President, Union Oil Company of California, Los Angeles, California.

Address: Benjamin F. Fairless, President, United States Steel Corporation, New York, N. Y.

Address: Speaker to be announced.

EXECUTIVE COMMITTEE

Executive Committee of the Board of Directors

Biltmore—Conference Room 8

12:30 PM Luncheon

GROUP SESSION

Agricultural Session

2:00 PM Biltmore—Conference Room 1

Presiding: E. A. Snyder, Socony-Vacuum Oil Company, Inc., New York, N. Y.

Program to be announced.

COMMITTEE MEETINGS
Division of Production

Sunday, November 12, 1950

Publications Committee (of the Central Committee on Drilling and Production Practice).
2:00 PM Biltmore—Conference Room 6
Chairman: T. H. Acres.

Monday, November 13, 1950

Central Committee on Measuring, Sampling, and Testing Natural Gas and Natural Gasoline.
9:00 AM Biltmore—Conference Room 6
Chairman: George P. Bunn.

9:00 AM Biltmore—Room 2328
Manufacturers' Subcommittee on Storage Tanks.
Chairman: H. C. Boardman.

9:00 AM Biltmore—Conference Room 1
Special Subcommittee on Pipe Research.
Chairman: B. B. Wescott.

9:00 AM Biltmore—Room 2234
Steering Committee on Drilling Practice.
Chairman: George E. Cannon.

9:00 AM Biltmore—Room 2352
Special Project Committee on Permeability (Code 27).
Chairman: George H. Fancher.

2:00 PM Biltmore—Conference Room 6
Central Committee on Vocational Training.
Chairman: John A. Ritter.

2:00 PM Biltmore—Room 2328
API-AWS Conference Committee on Tank Welding.
Presiding: Turner C. Smith.

2:00 PM Biltmore—Room 2234
Steering Committee on Production Practice.
Chairman: Paul Andrews.

6:00 PM Biltmore—Conference Room 7
Program Committee (of the Central Committee on Drilling and Production Practice) (Dinner).
Chairman: R. O. Garrett.

Tuesday, November 14, 1950

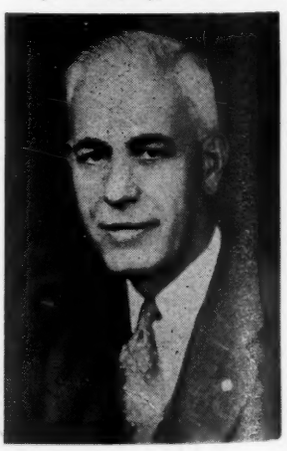
9:00 AM Biltmore—Conference Room 7
Joint Meeting on Storage Tanks.
Presiding: C. C. Ashley.

9:00 AM Biltmore—Room 2221
Executive Committee on Drilling and Production Practice.
Chairman: H. H. Kaveler.

H. C. Boardman, research engineer, Chicago Bridge and Iron, is chairman of the production division's subcommittee on storage tanks.

C. C. (Chet) Ashley, engineer, Shell Oil Company, will preside at a joint meeting on storage tanks (production division) at 9 a.m. Tuesday.

Turner C. Smith, General Petroleum Corporation, will preside at the API-AWS conference committee on tank welding at 2 p.m. Monday, November 13.



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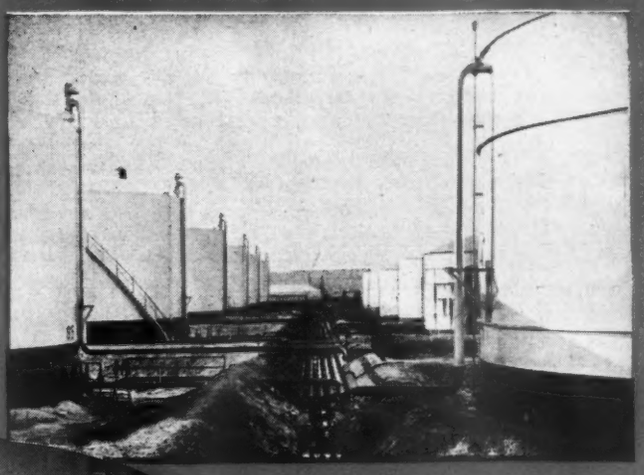

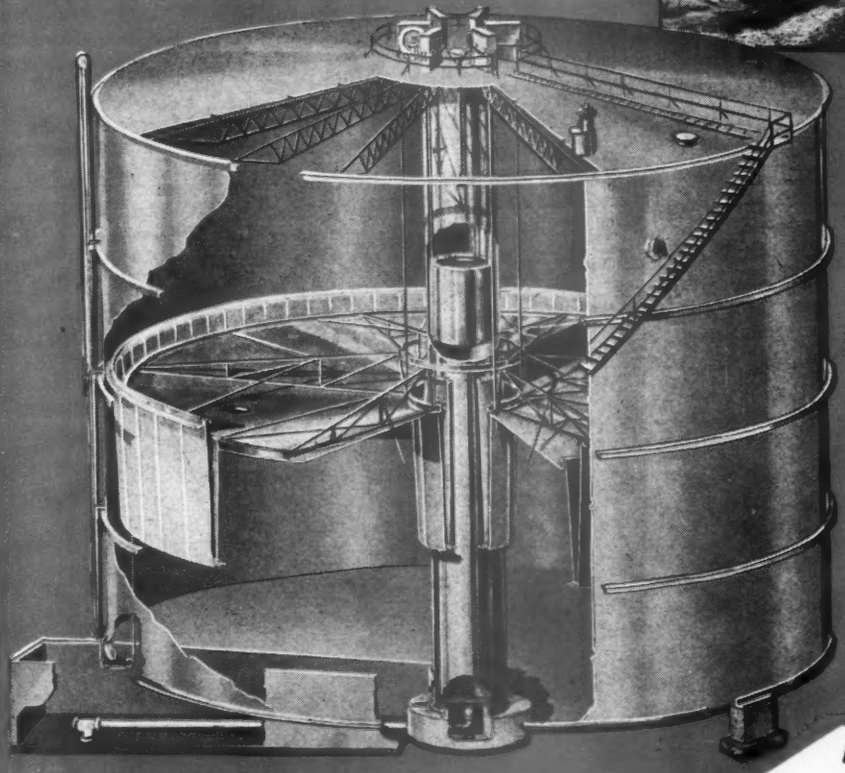

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12:15 PM Biltmore—Conference Room 8
General Committee, Division of Production (Luncheon).
Chairman: R. L. Wheelock.

2:00 PM Biltmore—Room 2221
Central Committee on District Activities.
Chairman: Harold S. Kelly.

4:30 PM Biltmore—Room 2219
Nominating Committee, Division of Production.
Chairman: J. E. Gosline.

Wednesday, November 15, 1950

9:00 AM Biltmore—Conference Room 5
Central Committee on Standardization of Oil-Field Equipment.
Chairman: John R. Suman.

Division of Refining

Thursday, November 9, 1950

9:00 AM Biltmore—Conference Room 7
Subcommittee on Sludges and Clays.
Chairman: J. A. Fowler.

10:00 AM Biltmore—Conference Room 7
Subcommittee on Waste Gases and Dusts.
Chairman: D. G. Stevens.

1:00 PM Biltmore—Conference Room 7
Subcommittee on Chemical Wastes.
Chairman: J. H. Easthagen.

2:00 PM Biltmore—Conference Room 11
Subcommittee on Oil-Water Separation.
Chairman: R. N. Giles.

3:00 PM Biltmore—Conference Room 7
Subcommittee on Sampling and Testing (Waste Disposal).
Chairman: R. J. Austin.

4:00 PM Biltmore—Conference Room 11
Subcommittee on Emulsions.
Chairman: W. E. Soden.

Friday, November 10, 1950

9:00 AM Biltmore—Conference Room 8
Committee on Disposal of Refinery Wastes.
Chairman: L. C. Burroughs.

9:00 AM Biltmore—Room 2223
Manufacturers' Subcommittee on Safety and Relief Valves.
Chairman: L. P. Stillman.

9:00 AM Biltmore—Room 2221
Joint Subcommittee on Field-assembled Vessels.
Chairman: W. L. Bowler.

9:00 AM Biltmore—Room 2219
Subcommittee of Refinery Inspection Supervisors.
Chairman: H. F. West.

Saturday, November 11, 1950

9:00 AM Biltmore—Room 2234
Subcommittee on Emission Spectroscopy.
Chairman: R. O. Clark.

9:00 AM Biltmore—Room 2228
Subcommittee on Tank Accessories and Cleanouts.
Chairman: E. E. Kerns.

9:00 AM Biltmore—Room 2219
Subcommittee on Corrosion.
Chairman: M. S. Northup.

11:00 AM Biltmore—Room 2234
Subcommittee on Oxygenated Compounds.
Chairman: W. H. Jones.

1:00 PM Biltmore—Room 2234
Subcommittee on X-ray Diffraction.
Chairman: E. B. Tucker.

Saturday, November 11, 1950

1:00 PM Biltmore—Room 2228
Subcommittee on Pressure - relieving Systems.
Acting Chairman: J. C. Souder.

2:00 PM Biltmore—Room 2225
Manufacturers' Subcommittee on Refinery Valves.
Chairman: W. P. Kliment.

3:00 PM Biltmore—Room 2234
Subcommittee on Nitrogen Determination.
Chairman: G. R. Lake.

5:00 PM Biltmore—Room 2234
Subcommittee on Trace Elements.
Chairman: Harry Levin.

Sunday, November 12, 1950

9:00 AM Biltmore—Conference Room 5
Committee on Petroleum Products.
Chairman: H. W. Field.

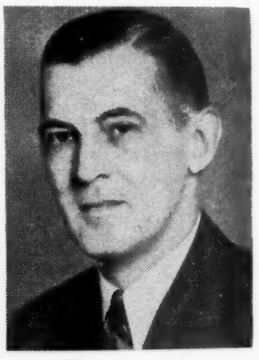
9:00 AM Biltmore—Conference Room 7
Subcommittee on Unfired Pressure Vessels.
Chairman: N. J. Rees.

E. F. Voss, chief refinery engineer, Humble Oil and Refining, is chairman of the refining subcommittee on mechanical equipment, which meets Monday.

L. M. Goldsmith, chief engineer, Atlantic Refining Company, is chairman of the subcommittee on electrical equipment, meeting Tuesday at 9 a.m.

N. J. Rees, development engineer, Socony-Vacuum Oil Company, is chairman of the subcommittee on unfired pressure vessels, meeting Sunday at 9 a.m.

Homer C. Reed, chief engineer, Union Oil Company, is chairman of refining division's subcommittee on valves, meeting at 9 a.m. Monday.



W. P. Kliment, engineer of standards, The Crane Company, is chairman of the manufacturers' subcommittee on refinery valves, meeting Saturday, 2 p.m.

George P. Bunn, Phillips Petroleum Company, is chairman of the production division's committee on natural gasoline and natural gas, meeting Monday.

E. L. Baldeschwieler, Standard Oil Development Company, is chairman of the refining division's committee on analytical research, which meets Monday.

Bonner H. Barnes, manager of manufacturing, Gulf Oil Corporation, is chairman of the refining division's committee on refinery equipment, which meets Monday.

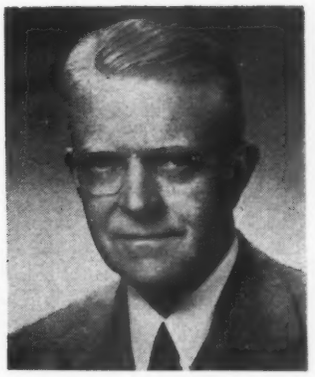
M. S. Northup, Standard Oil Development Company, is chairman of the subcommittee on corrosion, refining division, which meets at 9 a.m. Saturday.

William E. Soden, engineer, Sun Oil Company, is chairman of the refining division's subcommittee on emulsions, meeting at 4 p.m. Thursday.

H. H. Anderson, Shell Pipe Line vice president and general manager, is chairman of the subcommittee on pipe line technology, which meets all day Monday.

J. H. Peper, president, Buckeye Pipe Line, will preside at group session, 2 p.m. Tuesday. He is a member of central committee on pipe line transportation.

John W. de Groot, Tascarora Oil Company president, is subcommittee chairman of products pipe line technology.



J. M. Evans, chief engineer, Standard of California pipe line department, is chairman of pipe line hydraulics subcommittee, meeting Monday, 9 a.m.

Monday, November 13, 1950

9:00 AM Biltmore—Room 2229
Subcommittee on Mechanical Equipment.
Chairman: E. F. Voss.

9:00 AM Biltmore—Room 2232
Subcommittee on Valves.
Chairman: Homer Reed.

9:00 AM Biltmore—Room 2225
Committee on Analytical Research.
Chairman: E. L. Baldeschwieler.

1:00 PM Biltmore—Conference Room 9
Automotive Research Committee.
Chairman: D. P. Barnard.

1:00 PM Biltmore—Room 2219
Committee on Refinery Equipment.
Chairman: Bonner H. Barnes.

4:00 PM Biltmore—Conference Room 9
Advisory Committee, Division of Refining.
Chairman: John W. Newton.

Tuesday, November 14, 1950

9:00 AM Biltmore—Room 2219
Program Committee, Division of Refining.
Chairman: W. M. Holaday.

9:00 AM Biltmore—Room 2228
Subcommittee on Electrical Equipment.
Chairman: L. M. Goldsmith.

2:00 PM Biltmore—Conference Room 2
General Committee, Division of Refining.
Chairman: Chester F. Smith.

5:00 PM Biltmore—Conference Room 6
Nominating Committee, Division of Refining.
Chairman: G. L. Neely.

Division of Transportation

Sunday, November 12, 1950

2:00 PM Ambassador—Moderne Room
Subcommittee for Joint ASME - API Volumeter Research.
Chairman: L. S. Wrightsman.

Monday, November 13, 1950

9:00 AM Ambassador—Colonial Room
Joint Meeting (All Day):
Central Committee on Railroad Transportation (Fayette B. Dow, Chairman).
Committee on Car Service (B. C. Graves, Chairman).
Committee on Railroad Equipment (James E. Moss, Chairman).
Presiding: Fayette B. Dow.

9:00 AM Ambassador—West Gold Room
Central Committee on Radio Facilities All Day:
Chairman: F. W. Littell.

9:00 AM Ambassador—Theatre
Joint Meeting (All Day):
Committee on Pipe-Line Technology (H. H. Anderson, Chairman).
Subcommittee on External Corrosion (L. F. Scherer, Chairman).
Subcommittee on Products Pipe-Line Technology (J. W. de Groot, Chairman).
Subcommittee for Joint ASME-API Volumeter Research (L. S. Wrightsman, Chairman).
Subcommittee on Internal Corrosion of Crude-Oil Pipe Lines and Tanks (R. A. Brannon, Chairman).
Subcommittee on Lease-Tank Practices (R. Charles Nicholson, Chairman).
Subcommittee on Pipe - Line Construction Practices (H. E. Fisher, Chairman).
Subcommittee on Vocational Training (J. R. Mills, Jr., Chairman).
Subcommittee on Pipe-Line Crossings (R. H. Lynch, Chairman).
Subcommittee on Pipe-Line Hydraulics (J. M. Evans, Chairman).
Presiding: H. H. Anderson.

2:00 PM Ambassador—Oval Room
Joint Meeting.
Central Committee on Transportation by Water (T. E. Buchanan, Chairman).
Committee on Proposed Legislation (J. P. Patterson, Chairman).

Sidney P. Johnson, Standard of California engineering department, will give a paper Tuesday, 2 p.m. at a group session.

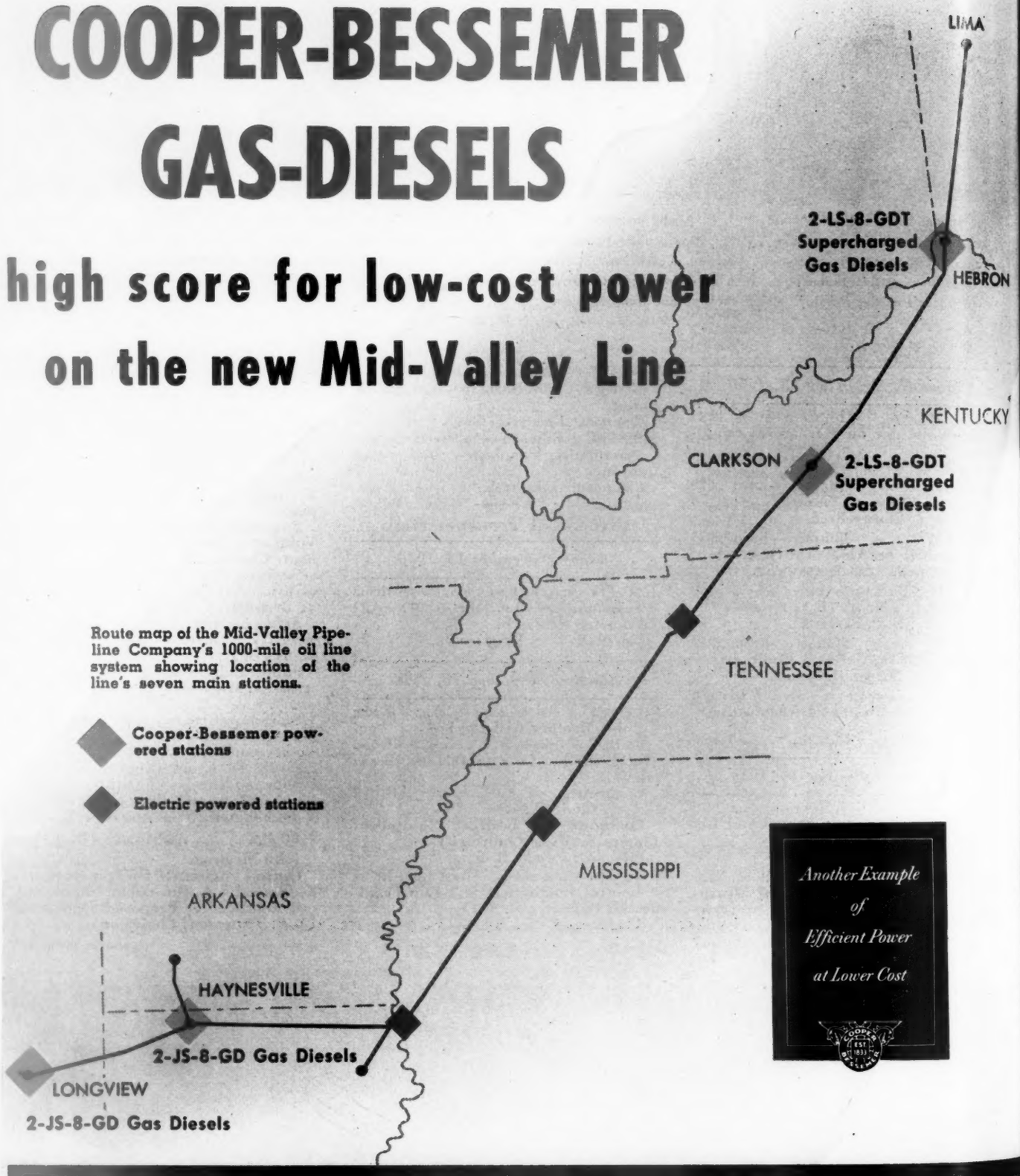
L. F. Scherer, The Texas Pipe Line Company, is chairman, external corrosion subcommittee, which meets all day Monday.

J. K. Alfred, Shell Pipe Line, will give a paper, 10:45 a.m. Tuesday, in a group session of the Division of Transportation.

R. A. Brannon, corrosion engineer, Humble Pipe Line, is chairman, internal corrosion subcommittee, meeting Monday.

COOPER-BESSEMER GAS-DIESELS

high score for low-cost power on the new Mid-Valley Line



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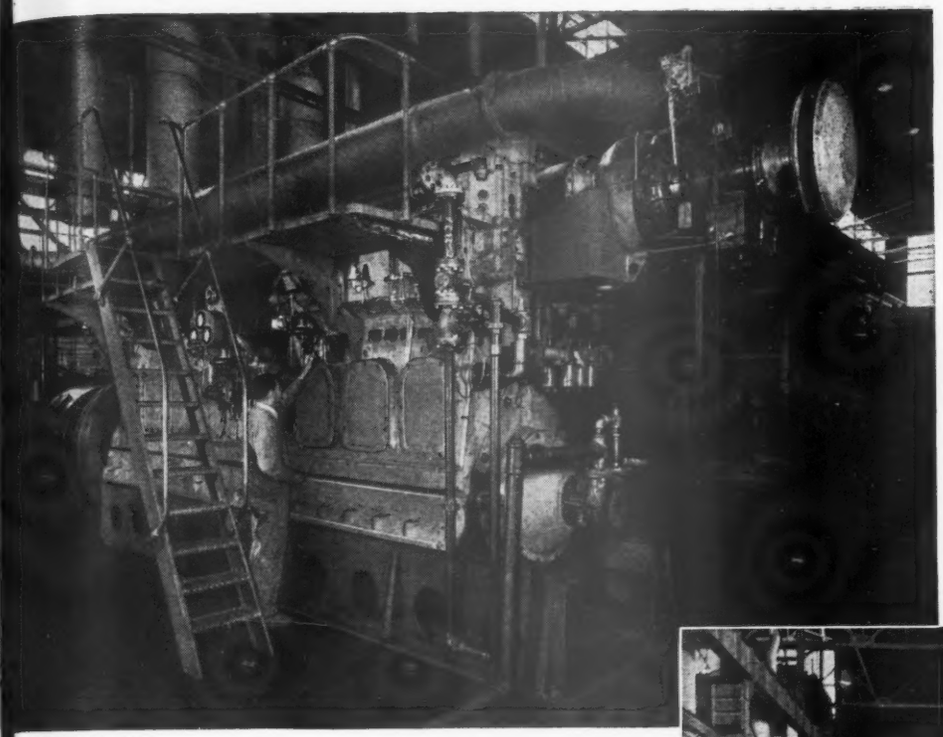
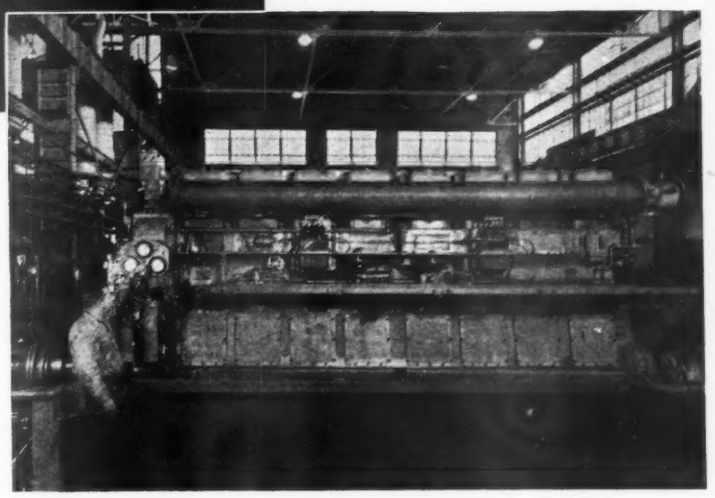


● B. F. Relf of Mid-Valley checking a supercharged LS-8 gas-diesel, rated 1715 hp at 327 rpm on the Cooper-Bessemer erection floor. Mid-Valley's Clarkson and Hebron stations in Kentucky will each be powered by two of these modern engines.

● C. N. Brindley of Mid-Valley checking a JS-8 gas-diesel, rated 800 hp at 450 rpm on the Cooper-Bessemer erection floor. Units of this type will power Mid-Valley's Longview, Texas, and Haynesville, La., stations—two engines for each station.



WHEN put into operation this Fall, Mid-Valley will be the most modern, most economical of the nation's cross-country oil lines. Highly significant, thorough studies proved that a combination of four gas-diesel powered stations and three electric powered stations assured peak economy. Modern, exceptionally efficient Cooper-Bessemer gas-diesels were picked for the job, will be located as shown on the map.

The smooth operation of Cooper-Bessemer gas-diesels on oil or any combination of gas and oil, means maximum flexibility and uninterrupted service. Even if the gas supply fails completely, these engines will continue to run, fueled by oil bled from the line.

If you have power needs coming up, you'll be wise to check into Cooper-Bessemer's latest money-saving engine developments—such as supercharged gas engines and gas-diesels . . . new gains in the power-to-space ratio of oil-burning diesels . . . and supercharged Turboflow compressor engines. Just get in touch with the nearest Cooper-Bessemer office.

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MOUNT VERNON, OHIO AND GROVE CITY, PENNA.

Houston, Dallas, Greggton, Pampa and Odessa, Texas Tulsa Shreveport St. Louis Los Angeles

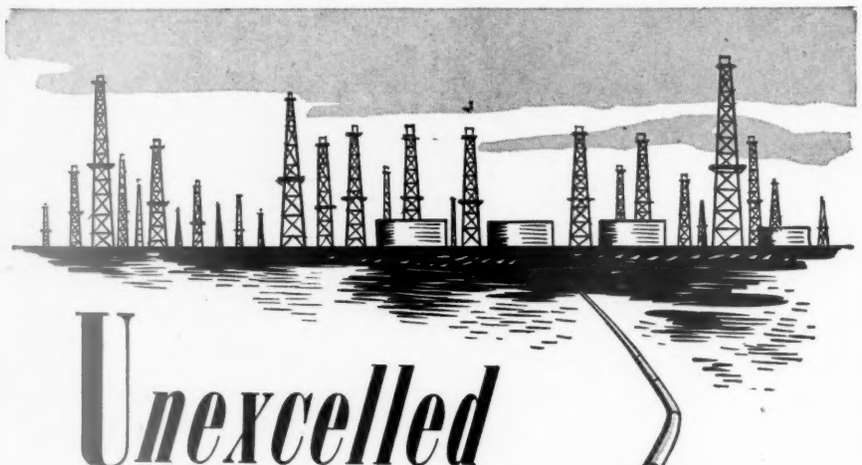
H. E. Fisher, chief engineer, products pipe line department, Standard (Indiana).

Carlton L. Goodwin, corrosion engineer, Portland Pipe Line, speaks Tuesday.

T. E. Swigart, vice president, Shell Pipe Line, will preside at group session.

R. H. Lynch, vice president, Keystone and Buffalo pipe line companies.

R. Charles Nicholson, superintendent of oil movements, Shell Pipe Line, will give a paper Tuesday.



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Committee on Tank Vessels (James E. Moss, Chairman).
Presiding: T. E. Buchanan.
5:00 PM Ambassador—Oval Room
Nominating Committee, Division of Transportation.
Chairman: J. H. Peper.

Tuesday, November 14, 1950

9:00 AM Ambassador—Moderne Room
Committee on Tank-Car Quantities.
Chairman: E. L. Hoffman.
9:00 AM Ambassador Theatre
Central Committee on Pipe-Line Transportation.
Chairman: J. H. Peper.
9:00 AM Ambassador—Colonial Room
Joint Meeting (All Day):
Central Committee on Automotive Transportation (Gavin W. Laurie, Chairman).
Committee on Regulations (M. E. Nuttila, Chairman).
Committee on Engineering (J. J. Powelson, Chairman).
Presiding: Gavin W. Laurie.

4:00 PM Ambassador Theatre
General Committee, Division of Transportation.
Chairman: T. E. Swigart.

Non-Divisional Committees

Friday, November 10, 1950

10:00 AM Biltmore—Conference Room 6
Committee on Awards (Accident).
Chairman: H. T. Markee.
2:00 PM Biltmore—Conference Room 6
Committee on Storage-Tank Venting.
Chairman: O. W. Johnson.

Saturday, November 11, 1950

9:00 AM Biltmore—Conference Room 8
Oil Industry Information Committee (Buffet Luncheon at Noon).
Chairman: George H. Freyermuth.
10:00 AM Biltmore—Room 2348
Committee on Static and Stray Currents.
Chairman: J. M. Pearson.
10:00 AM Biltmore—Room 2350
Committee on Accident Statistics.
Chairman: J. W. Lord.
1:00 PM Biltmore—Room 2348
Committee on Safe Marketing Practices.
Chairman: F. R. McLean.
3:00 PM Biltmore—Room 2350
Committee on Natural Gasoline.
Chairman: W. H. Boggess.

Sunday, November 12, 1950

9:00 AM Biltmore—Conference Room 8
Oil Industry Information Committee (Buffet Luncheon at Noon).
Chairman: George H. Freyermuth.

10:00 AM Ambassador—Oval Room)
Committee on Code 25—Measuring, Sampling, and Testing Crude Oil.
Chairman: H. H. Anderson.

10:00 AM Biltmore—Room 2348
Committee on Fire-Protection Engineering.
Chairman: J. E. Hill.

3:00 PM Biltmore—Room 2348
Committee on Visual Aids.
Chairman: C. R. Coneway.

8:00 PM Biltmore—Room 2348
Committee on Tank Cleaning.
Chairman: E. O. Jones.

8:00 PM Biltmore—Conference Room 8
Committee on Liquefied Petroleum Gas. Chairman: E. H. Barlow.

Monday, November 13, 1950

9:00 AM Biltmore—Conference Room 8
Oil Industry Information Committee (Buffet Luncheon at Noon).
Chairman: George H. Freyermuth.

9:00 AM Biltmore—Room 2331
Statistical Advisory Committee.
Acting Chairman: Fred Van Covern.

10:00 AM Biltmore—Conference Room 4
Financial and Accounting Committee.
Chairman: R. G. Rankin.

10:00 AM Biltmore—Conference Room 3
Program and Budget Review Committee.
Chairman: L. S. Wescoat.

10:00 AM Biltmore—Conference Room 2
American Petroleum Industries Committee.
Chairman: Oscar John Dorwin.

12:30 PM Biltmore—Conference Room 7
Public Relations Committee of the Board of Directors (Luncheon).
Chairman: John M. Lovejoy.

1:00 PM Biltmore—Room 2228
Committee on Fire-Protection Regulations.
Chairman: W. N. Young.

2:00 PM Biltmore—Conference Room 4
Financial and Accounting Committee.
Chairman: R. G. Rankin.

3:00 PM Biltmore—Room 2232
Committee on First Aid.
Chairman: C. A. Miller.

Tuesday, November 14, 1950

9:00 AM Biltmore—Conference Room 5
Oil Industry Information Committee (Buffet Luncheon at Noon).
Chairman: George H. Freyermuth.

9:00 AM Biltmore—Conference Room 6
Committee on Highways.
Chairman: R. L. Milligan.

9:00 AM Biltmore—Room 2331
Central Committee on Fire Protection. Chairman: J. E. Hill.

10:00 AM Biltmore—Conference Room 2
Advisory Committee on Fundamental Research on Occurrence and Recovery of Petroleum. Chairman: T. V. Moore.

10:00 AM Biltmore—Room 2348
Defense Services Committee.
Chairman: E. W. Berlin.

2:00 PM Biltmore—Conference Room 9
Advisory Committee on Fundamental Research on Composition and Properties of Petroleum. Chrmn.: H. G. Vesper.

8:00 PM Biltmore—Room 2228
Planning Committee, Central Committee on Fire Protection.
Chairman: J. E. Hill.

Wednesday, November 15, 1950

9:00 AM Biltmore—Conference Room 7
Planning Committee, Central Committee on Accident Prevention.
Chairman: C. L. Hightower.

12:30 PM Biltmore—Conference Room 8
Joint Meeting (Luncheon):
Central Committee on Accident Prevention (F. R. McLean, Chairman).
Central Committee on Fire Protection (J. E. Hill, Chairman).

12:30 PM Biltmore—Conference Room 6
Research Committee of the Board of Directors (Luncheon).
Chairman: Robert E. Wilson.

2:00 PM Biltmore—Conference Room 8
Central Committee on Accident Prevention. Chairman: F. R. McLean.

Thursday, November 16, 1950

12:30 PM Biltmore—Conference Room 5
Oil Industry Information Committee (Luncheon). George H. Freyermuth.

Friday, November 17, 1950

9:00 AM Biltmore—Conference Room 7
Committee on Agriculture.
Chairman: E. A. Snyder.

CNGA Celebrates Silver Anniversary

The California Natural Gasoline Association is celebrating its 25 years of service to the petroleum industry at its Silver Anniversary fall meeting November 9 and 10, 1950. The meeting highlights the progress of the natural gas and gasoline industry during the past quarter century, with papers being presented giving every natural gasoline man a better appreciation of his role in the petroleum industry, and the petroleum industry a better understanding of the function and problems of the natural gas and gasoline man.

PROGRAM

Thursday, November 9, 1950

Forum No. 1

"The Efficient Operation and Maintenance of Plant Equipment," J. B. Taylor, Signal Oil and Gas Company, Chairman. Room 429, Standard Oil Co. Building, 605 W. Olympic Blvd.

9:30 a.m.-11:30 a.m. "Preventive Maintenance and Overhaul of Engines," R. S. Ridgway, Standard Oil Company; "Hints on Maintenance and Operation of Cooling Equipment," Harold Dresser, The Marley Company, Inc.

1:30 p.m.-4:30 p.m. "Preventive Maintenance and Overhaul of Pumps," Paul Armstrong, Union Steam Pump Sales Company; "Operation and Maintenance of Boilers and Air Receivers," W. A. Carter, Pacific Indemnity Company, and "Paints—Their Use and Application," J. M. Hebden, Socony-Vacuum Oil Company, Inc.

Forum No. 2

"The Application of Chemical and Process Engineering Principles to the Efficient Design and Operation of Natural Gas Processing Plants," C. D. Gard, Union Oil Company, Chairman. Room 1227, Union Oil Co. Building, Seventh and Hope Streets.

9:30 a.m.-12:00 Noon. "Check List of Process Engineering Fundamentals," Dr. Frank J. Lockhart, University of Southern California; "Efficiency Characteristics of

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Commercial Absorbers," Ed G. Ragatz, Associate, J. B. Gill Company, and informal discussion on "Importance of Non Equilibrium Phenomena in the Design of Natural Gasoline Plants," Dr. B. H. Sage, California Institute of Technology.

1:30 p.m.-4:30 p.m. "Removal of Non-Hydrocarbon Constituents from Natural Gas," Arne Eriksen, Girdler Corporation; "Tray Efficiencies of Bubble Tray Absorbers," John C. Harper, California Research Corporation, now Associate Professor, University of California, Engineering Department, at Los Angeles; "Recent Developments in Multi-Component Distillation Calculations," Donald N. Hanson, Assistant Professor of Chemical Engineering, Berkeley Campus, University of California.

Forum No. 3

"The Role of the Chemist and Laboratory in Efficient Natural Gas Operations," W. W. Robinson, Jr., The Texas Company, Chairman. Conference Room 561, Southern California Gas Co. Bldg., 810 S. Flower St.

9:00 a.m.-12:30 p.m. "Reservoir P-V-T Relations and Natural Gas Manufacture," Dr. B. H. Sage, California Institute of Technology; "Testing Gasoline Plant Absorber Performance," R. A. King, Union Oil Company; "Testing Gasoline Plant Rectifier Performance," R. E. Baker, General Petroleum Corporation.

2:00 p.m.-4:30 p.m. "Testing Gasoline Plant Operating Efficiency," J. B. Armstrong, Standard Oil of California, and "Gasoline Plant Water Treatment," B. J. Willard and T. L. McCaleb, The Texas Company.

Forum No. 4

"Progress in Gasoline Plant Equipment and Design," M. W. Kibre, General Petroleum Corporation, and L. V. Leonard, Shell Oil Company, Co-Chairmen. Conference Room, Shell Building.

9:30 a.m.-12:00 Noon. "Gasoline Plants of Yesterday and Today," J. A. Campbell, J. A. Campbell Company; "Modern Design of Gasoline Plants," R. B. Cragin, Refinery Maintenance Company; "Report on Performance of Perforated Plate Tower," H. R. Marsh, J. B. Gill Company, and "Progress in Atmospheric Cooling Methods in Natural Gasoline Plants," G. H. Dieter, The Fluor Corporation, Ltd.

1:30 p.m.-4:30 p.m. "Pumping Trends in Natural Gasoline Plant Practice," Paul Armstrong, Union Steam Pump Sales Company; "Proper Application of Multi-Cylinder Gas-L.P.G. Engines for Gasoline Plant Requirements," John W. Tucker, Hall-Scott Motor Division; "Gas Purification Processes," A. L. Kohl, The Fluor Corporation, Ltd., and "Welding—Past, Present and Future in Refining Industry," S. R. Lanier, Southwest Welding and Manufacturing Company.

Forum No. 5

"The Efficient Management of Natural Gas and Natural Gasoline Operations," Wm. A. Kirk, California Southern Oil Co., Chairman. Conference Room No. 1, Biltmore Hotel, Los Angeles.

12:15 p.m. Luncheon meeting for management personnel; speaker, L. L. Purkey, manager department of organization, Standard Oil of California; subject, "Organization—The Working Tools of Organization Control."

Friday, November 10, 1950,
Los Angeles Ambassador Hotel

Morning Session

George C. McLaren, *Chairman*

9:00 a.m. Opening address by George C. McLaren, Standard Oil Co. of California, vice-president, California Natural Gasoline Association.

9:15 a.m. "The CNGA Technical Committee—What We Accomplished in 1949, and Our Plans for 1950," by A. C. Lyles, General Petroleum Corporation, Technical Committee chairman.

9:45 a.m. "Attaining Overall Efficiency in Natural Gas and Natural Gasoline Operations," R. W. Heath, Signal Oil and Gas Company, moderator. A panel discussion and recapitulation of forums held November 9 by the chairmen of those meetings.

11:00 a.m. "The Conservation of Natural Gas," by T. L. Taggart, Standard Oil Co. of California.

12:00 Noon—Adjournment of morning session by chairman.

12:15 p.m. Silver Anniversary Luncheon, Colonial Room, R. S. Tulin, chairman. Honoring past presidents — for directors and standing committee chairmen.

Afternoon Session

Frank J. Colton, *Chairman*

1:30 p.m. Opening of afternoon session by Frank J. Colton, Tide Water Associated Oil Company.

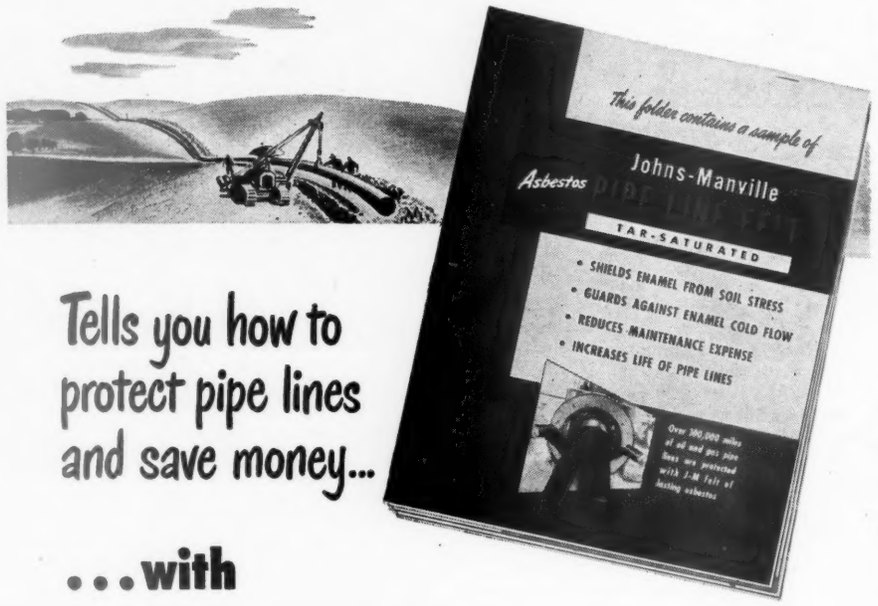
1:45 p.m. Greetings from Natural Gasoline Association of America, by James E. Pew, Sun Oil Company, president.

2:00 p.m. Greetings from the American Petroleum Institute, by Chas. S. Jones, president Richfield Oil Corp.

2:15 p.m. "The Light Hydrocarbons—Their Contribution to the American Way of Life," Warren H. Kraft, Honolulu Oil Corporation.

3:00 p.m. "Human Relations in the Natural Gas and Natural Gasoline Industries," H. L. Eggleston, analyst.

3:45 p.m. "Twenty-five Years of CNGA—Its Service to the Industry," by R. S. Tulin, Shell Oil Company, CNGA president. ★ ★



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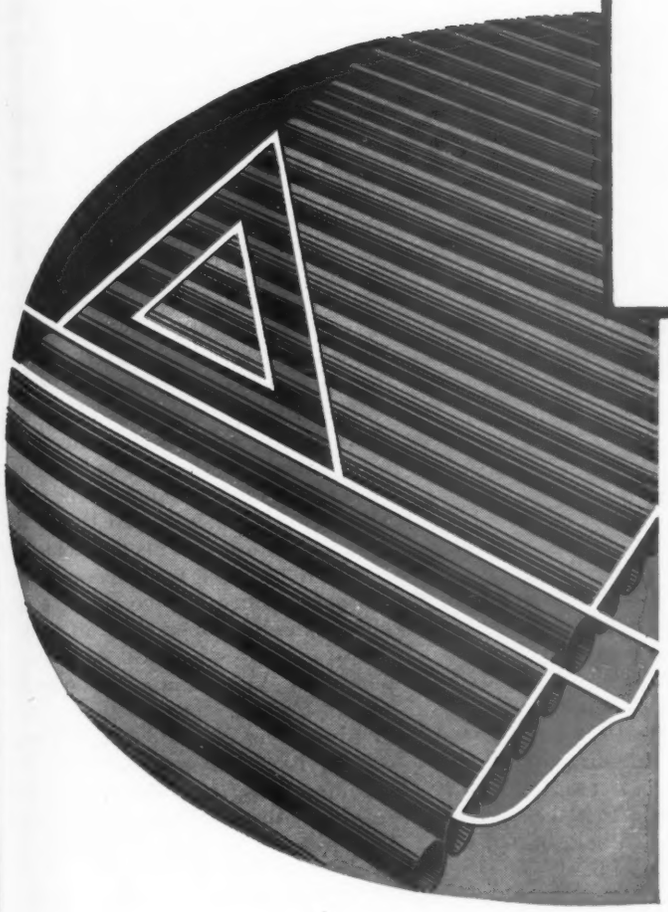

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PETROLEUM PROFILE

Sir George Legh-Jones
Managing Director
Shell Transport and Trading Company

SIR GEORGE LEGH-JONES ("L.-J." for short) who has served the interests of the Royal Dutch-Shell Group with singular ability and distinction for over three decades, is a cosmopolitan Welshman equally at home in San Francisco, New York, London, and The Hague. Born on March 24, 1890, eldest son of Edward and Emily Legh-Jones, and educated at Oswestry and Welshpool Schools, young Legh-Jones saw active service in World War I, first with the Artists' Rifles and later as a commissioned officer in the Royal Welch Fusiliers. Toward the end of the war he was seconded to the Admiralty Department dealing with oil tankers and supplies, and in 1918 he was attached to the British Shipping Mission in Washington.

Sir George began his career with the Royal Dutch-Shell Group in 1919, as manager of the Fuel Oil Department of the Asiatic Petroleum Company. Two years later he spent some months in The Hague Office, and in 1922 came to the United States as president of Shell Oil Company in California. Later, he became a director of Shell Union Oil Corporation of New York, and a director of the American Petroleum Institute. Sir George left the United States in 1934 to become manager of the Anglo-Saxon Petroleum Company, and after three years he was appointed to the board of the Shell Transport and Trading Company and made a managing director of the group's principal operating companies. In June 1944 he was appointed a managing director of the Shell Transport and Trading Company and in March 1949 he became a director of Lloyds Bank, one of the "Big Five" British banks.

Prominent among Sir George's multifarious activities within the Shell group must be singled out first the numerous major financial transactions in which he played a leading part and second, his close association with the growth and development of the Shell tanker fleet. The former include the arrangements whereby Shell Transport and Trading Company raised nearly £28,000,000 ($112,000,000) in 1947 through the issue of £10,000,000 new ordinary shares; the raising of a loan of $250,000,000 in the United States in October 1948, thereby providing Shell with dollar capital for the development of petroleum exploration and production in the Western Hemisphere; and the Shell Transport and Trading Company's purchase of the minority share capital of Venezuelan Oil Concessions in 1949. When U. boats were taking a heavy toll of Allied tankers, especially in the Caribbean and the Atlantic seaboard of the United States in 1942, Sir George was largely responsible for the Group embarking on the construction of the large tankers *Helicina* and *Hyalina*.

The Shell issue of £28,000,000 ($112,000,000) in November 1947 was the biggest single piece of private financing ever known in London, and naturally caused a flutter in the City. The following October the Shell Caribbean Petroleum Company (a wholly-owned subsidiary of the Royal Dutch-Shell Group) of which Sir George is chairman, signed a contract for the sale at par to a group of American and Canadian insurance companies of an issue of $250,000,000 four per cent bonds maturing in 1968. A sinking fund beginning in the sixth year at the rate of $10,000,000 per annum will amortise 60 per cent of the loan by maturity. To conclude this world record deal Sir George had to bring the Treasury in Washington, the Dutch Ministry of Finance, and the British Treasury into line. This financing was intended to meet the necessary capital expenditure for the Group's rapidly expanding operations in a number of countries in Latin America, in particular Venezuela and Colombia, and in Canada. It enabled the Group to procure in North America a large part of its dollar requirements. Thus without calling for additional dollars from the British Treasury, Shell has been able to speed up its considerable expansion program in the New World.

Sir George Legh-Jones is a country-lover condemned to work in the City. Rather than live in London he travels up every day from his 250-acre Hartley Witney Farm near Basingstoke where he lives with his wife whom he married in 1915. Just turned sixty, "L.J." is dark, powerfully built, and impeccably dressed. Having spent several years in the United States he has acquired that brisk and decisive trans-Atlantic manner. His hobbies are many. He breeds Guernsey cattle, grows sweet peas (which have won several prizes at the Chelsea Flower show) enjoys dry fly fishing and game shooting. He has a married daughter and two young grandchildren. He is happy arguing about vintages with his son-in-law wine merchant, Peter Adams.

More Oil Wells and Steel Needed?

ALTHOUGH U. S. drilling operations are near the 1948 peak of 2457 active rotary rigs, the net gain in the number of oil wells at the end of 1950 will probably be a little less than 11,000, or about 2.4 per cent more than the number of oil wells at the end of 1949. Thus, the gain in the number of oil wells in the U. S. is not keeping up with the gain in demand for oil, which exceeds 10 per cent so far this year.

Although 42,000 wells may be drilled during 1950, only about 23,000 of them will be completed successfully as oil producers. And, although this represents a substantial increase of slightly more than 5 per cent to the 449,000 oil wells that were producing at the end of 1949, the increase will be reduced by the abandonment of some 12,000 depleted wells that are being plugged during 1950. The net gain, then, after replacing the abandoned wells, will be only about 11,000 wells, which means that the U. S. will have about 460,000 producing oil wells at the end of 1950.

It is true, of course, that the new wells have a much larger producing capacity than the small wells that are abandoned; however, the total producing capacity of the 449,000 wells, which were producing at the beginning of the year, has declined during 1950. The extent of this decline in producing capacity is hidden by increased production from wells in prorated fields that have excess producing capacity, and by the increased production from wells in fields that are waterflooded and repressured.

The overall result of not drilling enough new oil wells every year to keep up with the increasing demand is indicated, however, by the gradual increase in the average daily production of all oil wells from 7.5 bbl per day in 1930 to about 12 bbl per day per well in 1950. Whether or not the oil wells in the U. S. in 1970 will be capable of supplying the increased demand may well depend on whether or not more steel and capital are allocated now and during the next nineteen years to the drilling and completion of a substantially greater number of oil wells per year.

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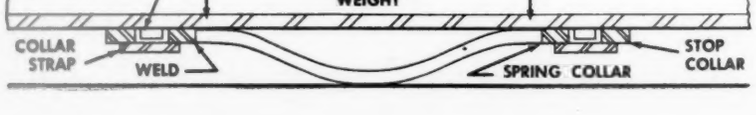


THIS SIMPLE ILLUSTRATION REVEALS THE IDEAL IN SPRING DESIGN AND MOUNTING, WHICH IS FOUND ONLY IN THE BAKER MODEL "G" CASING CENTRALIZER. Note how the load point is imposed directly upon the casing; and how the properly "contoured" spring is free to move along the smooth surface of the casing as the spring deflects under compression. There is no chance for concentration of stress to cause a permanent set, or to result in breaking the spring. Note that ample clearance exists between Stop Rings and Spring Collars to accommodate the increased length of the springs which results from their complete flattening as the centralizer passes dog-legs or tight spots in the hole.

ANALYSIS

Gas Lift Operations and Problems

C. V. KIRKPATRICK*

THE production of oil by gas-lift is an operation that has been marked by a rather unique evolutionary background. As is true with most basic operating principles, this application has evolved from an humble beginning in 1864. Early applications saw numerous failures due to lack of necessary engineering data. This was an unfortunate, but understandable experience, which resulted in a sharp curtailment of the application for many years.

As the mechanisms governing reservoir performance became understood, however, and as valves for controlling gas injection and methods for operating these valves were developed, gas-lift installations again began to be employed in many areas. The development of the "Chamber" method of producing low capacity wells, and other mechanical refinements in valve operation and control, helped gas-lift attain its present important position in the production of oil.

Gas-lift should no longer be regarded as an intermediate lifting method. Many applications could be accomplished only by gas-lift. It is proposed to present in this analysis a general up-to-date coverage of the mechanics of valve operation, application and performance, operating difficulties, and probable future developments.

Mechanics of Valve Operation

A thorough knowledge by the operator of the mechanics of the gas-lift valve or injection device is essential for maximum efficient operation. All are basically simple in principle and can be understood easily. Jet nipples, perforated collars, or orifice buttons are, as the names imply, simply orifices in the tubing string. These are suitable for an economical installation in high-fluid-level, high-productivity-index, continuous-flow wells, where efficiency or performance is not a major factor. Orifice buttons can be inserted at desired levels in the tubing string without pulling the tubing. These devices have been used effectively to unload the annulus in wells bridged by sand.

Gas-lift valves may be considered in two major categories: Those that are essentially "automatic" in operation and those that are controlled from the surface. The automatic or differential type valve may be divided into two types: Those that are inherently-open and those that are inherently-closed. These valves are both dependent upon the differential pressure between the casing and the tubing. A familiar type of the inherently-open valve is the spring-loaded type in which the gas pressure in the annulus must overcome the pressure exerted by the well fluid in the tubing. The valve spring may be of any desired differential setting. A second type entirely different in mechanical design, but similar in operating principle, is the specific-gravity-differential valve. This valve is shown schematically in Fig. 1. These valves operate best in high-fluid-level, continuous-flow wells, but are not necessarily restricted to this well condition. When operating in low productivity wells, however, it is recommended for the spring-loaded valves that no surface choke be used and that trap pressures be kept at an absolute minimum.

The inherently-closed type of differential valve is usually of the bellows or spring type, or bellows and spring type. In other words, the loading force is exerted by a charged bellows, a spring, or a combination of charged bellows and spring. This valve may be surface-controlled, if desired, or automatic in operation. Other characteristics are: All valves may be charged at the same pressure; in high-capacity wells, the annulus liquid can be prevented from passing through the valve; the valve will operate against a surface choke; and it may minimize the producing gas:oil ratio in reservoirs where the formation gas:oil ratio is high. It is cautioned that the specific function and application of this valve should be thoroughly understood and differentiated from the other differential types.

The second major category, the surface-controlled valve, is of three general types. The actual control falls under only two divisions, the wire-line control and the pressure-control, but under the pressure-control operation there are several mechanically different valves. The wire-line control valve is operated by raising and lowering a weight bar suspended on a wire-line in the well. The control is automatic at the surface and when the bar is opposite the valve gas can be injected. This valve provides simplicity, positive operation, and large valve ports for maximum starting velocities. It has the disadvantage, however, of the well bore restriction and mechanical wire-line operation.

The pressure-controlled valves have a pilot valve that uses a combination liquid-charged bellows and spring (see Fig. 2), a gas-pressured bellows valve, and a combination gas-pressured bellows and spring valve (see Fig. 3). The pilot operated valve seen in Fig. 2 has the upper bellows charged with a liquid that has a low coefficient of thermal expansion, and an adjustable spring that is likewise unaffected by well temperatures. This forms the "pilot" of the valve. The lower bellows, which controls the entry of gas

*Director, Department of Petroleum and Natural Gas Engineering, The University of Houston, Houston, Texas.

EXCLUSIVE

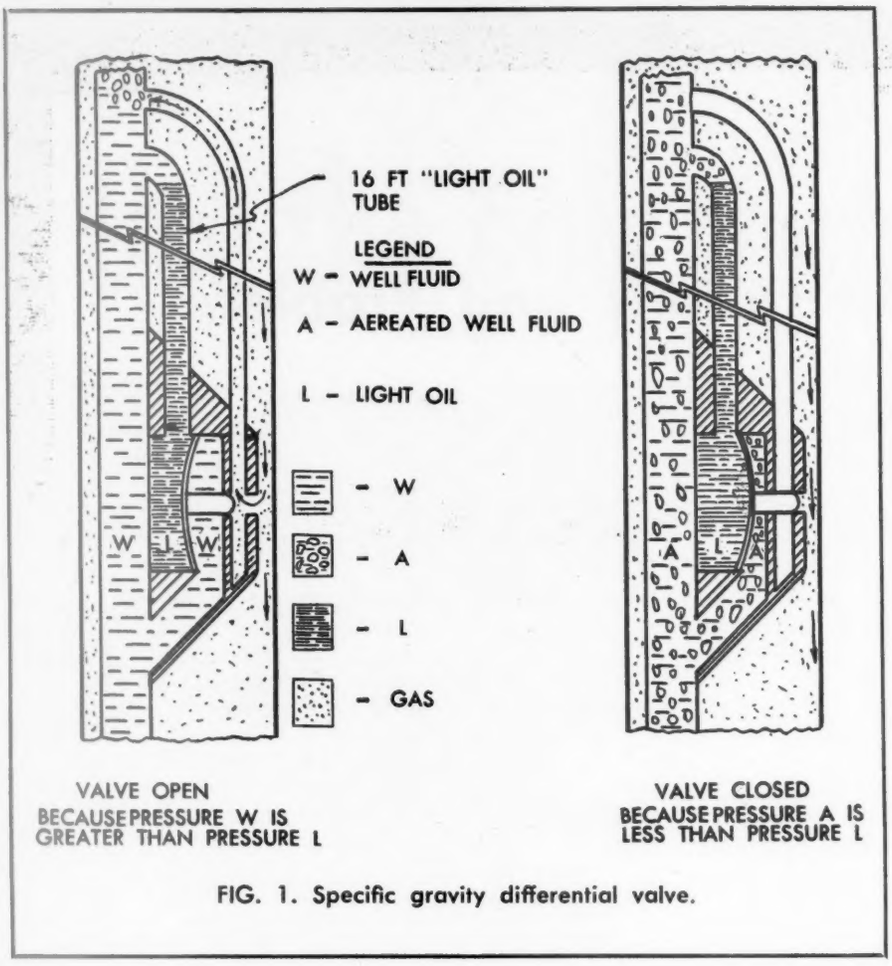


FIG. 1. Specific gravity differential valve.

into the tubing, offers no resistance to the opening force of the gas admitted by the "pilot", giving a full and instantaneous valve opening. This reduction of the throttling effect imparts a high initial velocity to the well fluid which, in turn, increases the efficiency of the operation.

The gas bellows and spring valve shown in Fig. 3 has a pre-pressurized bellows that minimize bellows rupture, and an adjustable spring. The spring is designed to reduce the effect of the temperature on the gas charged bellows and acts as a safety factor in the event of the bellows failure. The spring also permits field adjustment of the valve. The gas-charged bellows has a liquid in the sealing charge of the bellows for the purpose of reducing bellows rupture. Most gas bellows valves are charged with nitrogen at 60 F.

The pressure-loaded valves are controlled from the surface on a time-injection basis, a pressure-control basis, or a combination of the two. The chart shown in Fig. 4 is for the purpose of estimating wellhead pressures for gas-charged valves. The chart has been prepared for normal temperature gradients at operating depths as set forth by the Houston Geological Society Study Group Papers of 1946. These temperatures will probably be within 20 deg of the actual temperature in most cases. The temperature gradient increases, however, toward the interior of the states of Texas and Louisiana. The chart has been computed for an average lift-gas gravity of 0.60. Gravity corrections can be made readily, however, with the use of the curves shown in Fig. 5. These curves give the pressure due to the weight of a gas column for a given wellhead pressure, operating depth, and temperature.

All the pressure-charged valves come in varying sizes with the larger ones having ports sufficiently large to pass an ample volume of gas at great depths. In addition to the valves and jet collars, the plunger lift should be mentioned, as its application is increasing. The plunger merely acts like a rod pump with a stroke length as long as the tubing string. Its primary application is in deep wells where limited amounts of oil must be lifted with a low gas pressure, however, it is not restricted to this type of operation.

Application and Performance

There would seem to be but one major factor limiting the application of gas-lift, and that is available gas. An operator should be sure that he will have an ample supply throughout the life of the field. Formerly, this requirement had to be stated as "available *high-pressure* gas," however, effective application of unit compressor installations, both from the standpoint of economy and capacity has minimized this problem. One operator reports his costs to be $0.30 per barrel of oil using a compressor unit with a maximum output of 500 mcf per day at intake and discharge pressures of 20 and 500 psig, respectively. This installation is now handling 5 wells. Two large operators have reported the cost as averaging $0.002 per horsepower hour. A figure of $0.02 per mcf for compression cost is probably representative. Instances are reported of operators paying as much as $0.15 per 1000 cu ft for high-pressure gas for gas lift operations in closed systems. There are many areas where high-pressure gas is available from near-by gasoline plants.

In order to obtain best results, a gas-lift installation should be designed with full reservoir information. These data include bottom-hole pressures and temperatures, temperature and pressure gradient, formation GOR, productivity index, static gradient, static fluid level, flowing gradient, sand, paraffin, and emulsion conditions. It should be emphasized that, for many installations, these data are essential for maximum returns. It should be emphasized further that each well presents an individual problem and should be treated as such.

Much attention should also be devoted to the selection of the proper type valve for each well. Although there may be little difference in the performance of the same general type valve made by the different manufacturers, there is a considerable difference in the performance of different types of valves for given well conditions. Basically, it would seem that there are but two different types of flowing conditions, continuous and intermittent, or "slug" flow. The continuous represents the aereated fluid column with an ever increasing volume of gas breaking out of the liquid as it travels up the well bore. The slug flow may be likened to the piston effect of the plunger pump. This would suggest that there must be a maximum depth below which the continuous flow operation would produce an excess GOR, and that in the case of the slug flow, subject to certain controllable conditions, there would be no depth limitation within reasonable limits.

It has been suggested by one gas-lift authority that the depth limitation for continuous flow operations may be estimated reasonably by dividing the difference between the operating

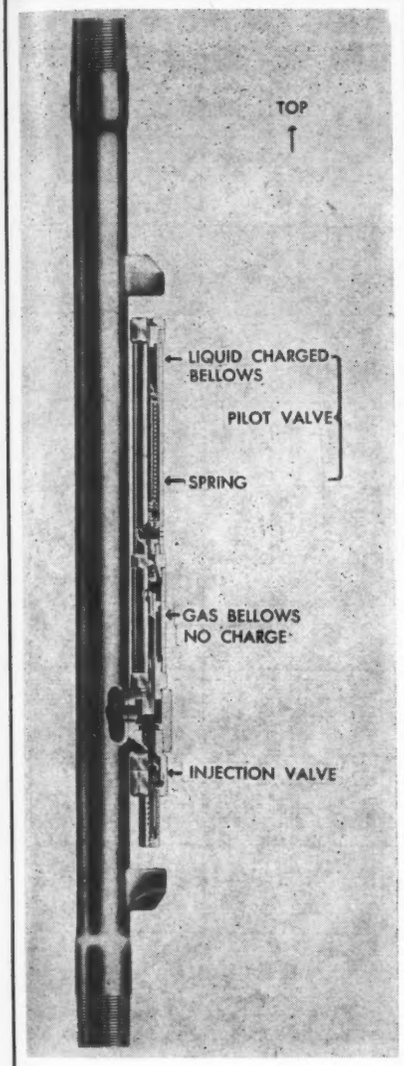


FIG. 2. Piloted operated gas lift valve.

annulus pressure and a predetermined valve differential by an estimated flowing gradient. Others have suggested that this depth for many wells has been found to be about 4000 ft. Wells producing as much as 200 bbl per day through 2 in. tubing and wells producing in excess of 250 bbl per day through 2½ in. tubing are usually designed for continuous flow. Production of less than these amounts of total fluid are usually designed for intermittent flow.

It is well known that gas-lift is highly effective in water drive reservoirs where large amounts of fluid must be produced in order for the wells to "pay-out." It is not so well known, however, that gas-lift has also been effective in reservoirs with low bottom hole pressures, low fluid volumes, and low formation GORs.

Wells now being gas-lifted produce from 2 bbl of fluid to as much as 15,000 bbl daily. Bottom hole pressures range from as little as 35 psig to as much as 4000 psig. In some reservoirs where the formation GOR is exceptionally high, the use of the continuous-flow type differential valve has been effective. Some few wells are now being gas-lifted below 10,000 ft, and one operator reports several operating below 8000 ft with GORs not in excess of 2500 to 1.

The use of the "chamber" type installation (see Fig. 6), which keeps the injected gas off the producing formation, has been feasible for depletion of low volume wells. A combination of flow valves and the plunger lift (see Fig. 7) has extended the flexibility of the gas-lift operation. This type installation is most applicable in wells that have a rapidly declining productivity index and formation GOR. Gas-lift has also been adapted effectively for dually-completed wells. Much research is in progress with the view of furthering this development (see Fig. 8). Back-washing water injection and water disposal wells, and "swabbing", represent additional applications of the gas-lift operation.

One of the most severe physical limitations to the gas-lift operation is a low API gravity crude. With high water production, the problem is alleviated somewhat (one operator reports effective operations with a 12 deg API gravity crude and 80 per cent water), but, in general, crudes below 26 deg API gravity are apt to produce excess GORs.

Operating Problems

The operating difficulties can be divided into 2 categories, mechanical and operational. The term operational is used here as meaning the difficulties physically inherent in the reservoir. The mechanical difficulties are due to leaking or sticking valves, diaphragm or bellows rupture, and gasket and packing failures. The sticking valve trouble can be remedied sometimes by equalizing the tubing and casing pressure and then suddenly releasing the tubing pressure. Casing and tubing leaks have often been found to be the real "cause" of a suspected leaking valve. The rupture of bellows and diaphragms is relatively rare (one report giving 1 in 300). Blasting of the injection gas directly against the tubing, casing, or valve body has caused excessive "cutting out" in the past, however, new designs have minimized this difficulty. The mechanical difficulties have largely been overcome, or at least reduced to a controllable minimum, with the result that a much greater percentage of the pulling jobs are due to other causes.

In the operational category, the production of sand can present a very severe problem. This problem offers a greater operational hazard to the intermittent than the continuous flow operation. A small amount of sand may be produced under continuous flow conditions, however, if well conditions are favorable, producing against a small surface choke may minimize the problem. It should be cautioned here, however, that the apparent remedy to one problem may

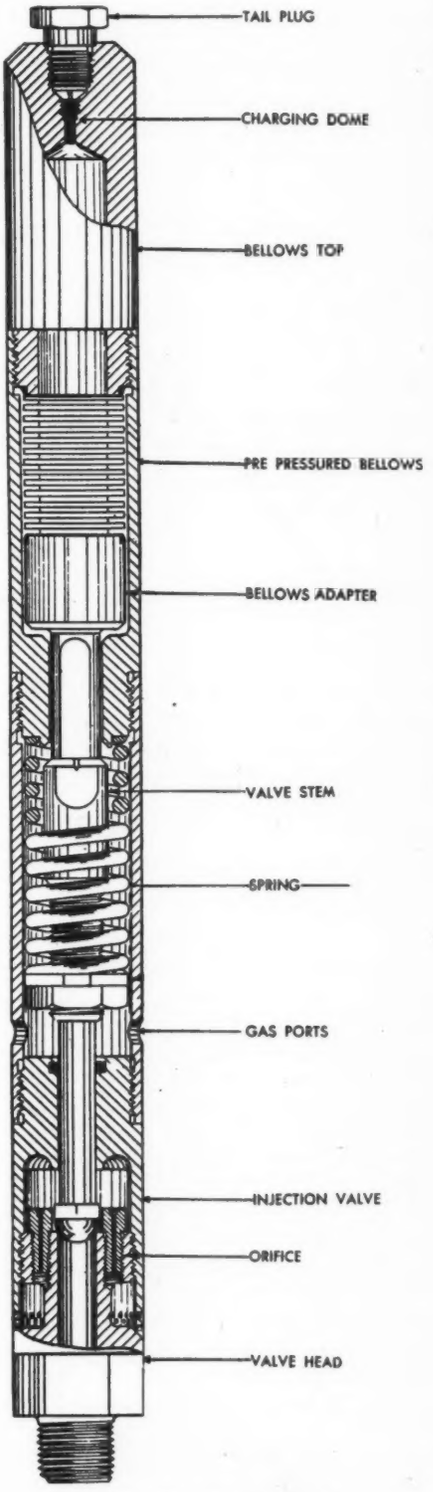
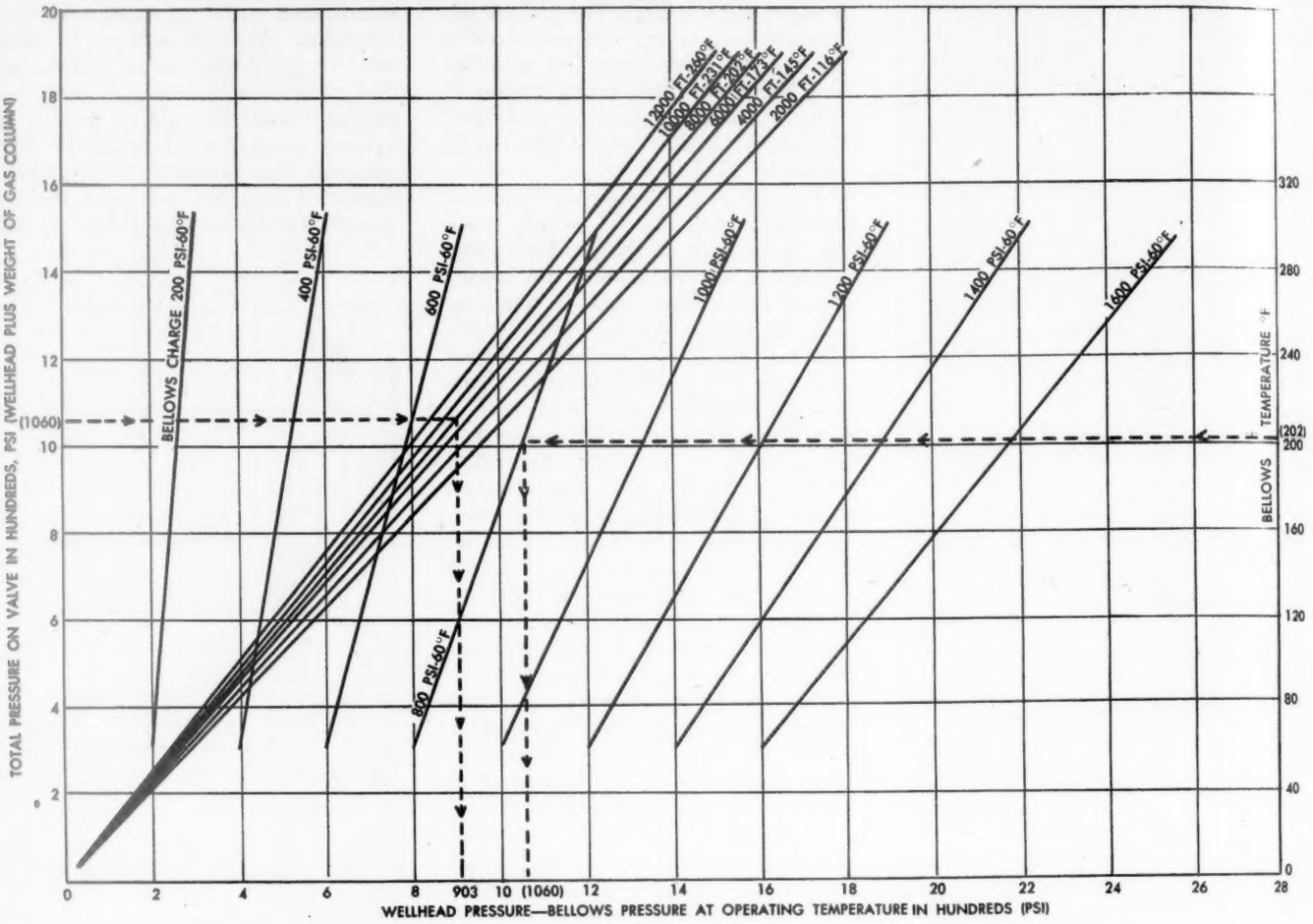


FIG. 3. Bellows and spring gas lift valve.

FIG. 4. Chart for estimating wellhead pressure for gas-charged bellows valve. (Gravity of gas = 0.60.)

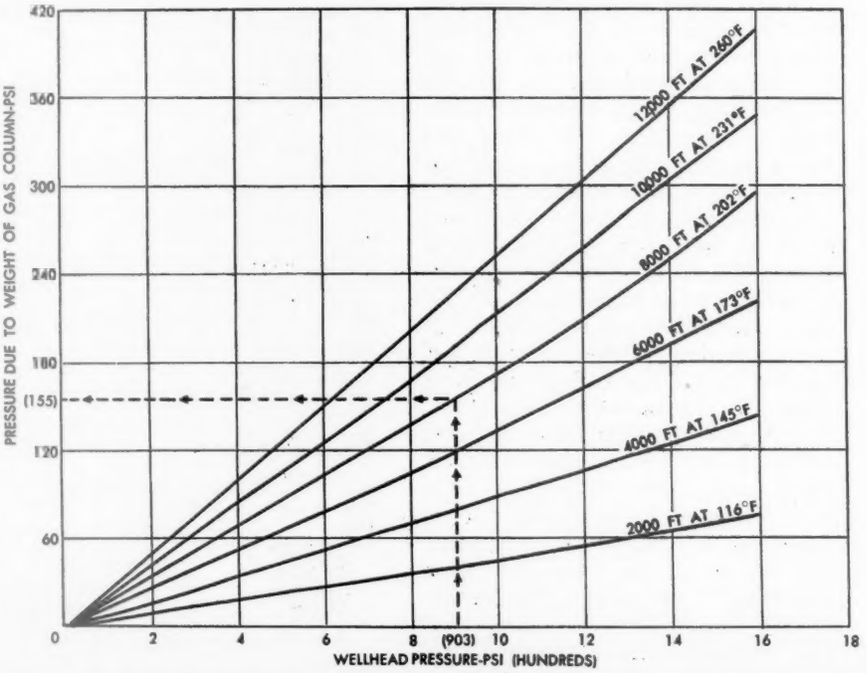


USE OF CHART

1. Assume 800 psig at 60°F valve is to be set at 8000′.
2. From chart it is seen that the normal temp. at 8000′ is 202°F.
3. The intersection of the 202°F and the 800 psig at 60°F curve gives 1060 psi as the bellows P at operating temp.
4. Intersection of 1060 psi total pressure on valve and 8000′ at 202°F gives a wellhead pressure of 903 psig.

NOTE: Chart is for nitrogen charged bellows and 0.60 gravity lift gas. To correct for gravity see other chart with this article.

FIG. 5. Chart for estimating pressure due to weight of gas column.



USE OF CHART

1. Assume gravity of lift gas is 0.65 and 903 psig has been determined as wellhead pressure for an 800 psig at 60°F valve set at 8000′ for a 0.60 gravity gas.
2. Intersection of 903 psig and 8000′ at 202°F curve gives 155 psi as pressure due to weight of 0.60 gravity gas column.
3. Hence $155 \times \frac{0.65}{0.60} = 168$ psi due to weight of 0.65 gravity gas at 8000′ — 202°F and 903 psig wellhead pressure.
4. Then 168 — 155 = 13 psi additional pressure due to weight of 0.65 gravity gas.
5. Hence wellhead pressure for 0.65 gravity gas is 903 — 13 = 890 psig.

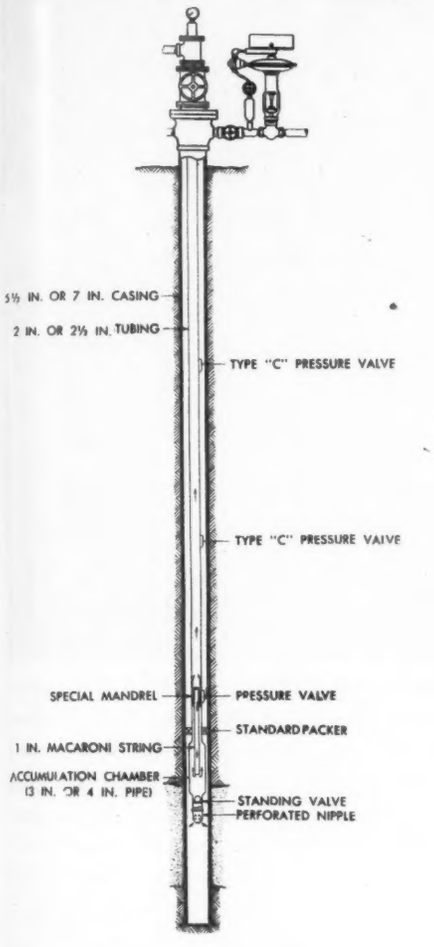


FIG. 6. Chamber installation.

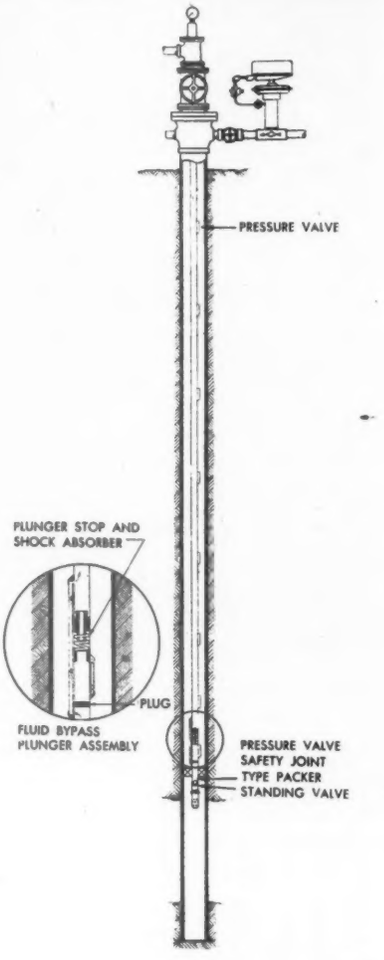


FIG. 7. Combination pressure valve-plunger lift installation.

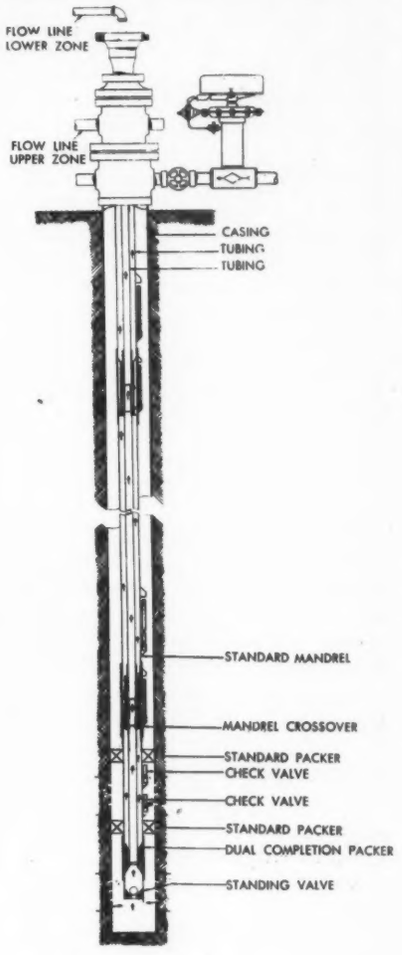


FIG. 8. Dual completion installation.

lead to another of a more serious nature. Many gas-lift installations operate most efficiently against a minimum of surface restrictions. Before back pressure is applied at the wellhead, therefore, one should determine whether or not conditions are favorable for such operation.

Paraffin deposition can cause considerable trouble in gas-lift operations. This problem seems to be minimized in some cases, however, if the well is making a high percentage of water, as the heat from the water reduces the tendency of the paraffin to deposit. This advantage is probably offset, however, by the tendency of oil and water to emulsify. Such emulsions increase paraffin deposition.

Emulsions constitute another problem that is closely allied with the low API gravity crude problem. It is rare, however, that the emulsification problem is so severe as to curtail gas-lift operations except in the case of very low gravity crudes.

Inorganic salt deposits have been a problem in some areas, however, the injection of some fresh water along with the gas has tended to overcome the problem by dissolving the salts.

Future Developments

It has been pointed out that exceptional progress in the development and application of gas-lift has been made in the past few years. This development has paralleled to a large degree the increased understanding of the fundamentals of reservoir behavior. This would seem to indicate that even greater progress may be expected in the future. "Automatic" operation of an intermitting type flow valve at depths in excess of 10,000 ft without excessive GORs is now in the experimental stage of development. An "Educated Plunger," one that will return to the surface after a predetermined fluid head has been built up and not after a predetermined time interval, is in the developmental stage. The low API gravity crude problem is being given much attention in the form of a combination flow valve and plunger lift operation. Operators are interested in the development of equipment that will handle dual completions by pulling only one string of the concentric tubing, as well as further refinement of the dual completion gas-lift operation.

Aside from equipment, there is a definite need for additional engineering data, and it would seem that this data must of necessity be empirical. How much pressure is required for efficient lifting under a given set of conditions? How does the flowing gradient vary with liquid gravity, GOR, and tubing size? What *is* the most efficient valve spacing for the different type valves under a given set of conditions? What effect does formation GOR have on the design of an installation? These and many other related questions must be answered before the optimum in gas-lift design can be reached.

Conclusion

The scope of this paper has purposely omitted the inclusion of formulas for valve spacing, the quantita-

tive effect of formation GOR, installation efficiencies, and other quantitative evaluations that are necessarily vital for an effective gas-lift design. To have done so would have extended an already lengthy presentation beyond desirable limits. These factors are, in themselves, subject matter for a complete discussion. It has been the intent to present a broad up-to-date analysis of the gas-lift operation. Mechanical function and operation of the different type valves has been presented, because it is believed that a thorough understanding of their proper function and application can be had only through a knowledge of their mechanical principles. It is concluded that there is little difference in the performance of similar type valves, but that great emphasis should be placed on the selection of a particular type valve for a given well condition. It has been emphasized further that complete reservoir information should be available for optimum gas-lift installation design. It can be shown in many instances that to make the installation without this information is definitely false economy. Charts have been prepared to aid in the estimation of some of these variables, however, it should again be emphasized that no chart can incorporate the many variables and abnormalities of an area, particularly the Gulf Coast. New developments have made the economic depletion of different type reservoirs a reality. Deep wells and wells producing large volumes of fluid have been produced effectively by gas-lift. The limitations of the gas-lift operation are two-fold. First and most serious was lack of gas. This problem is being alleviated in some areas where low pressure gas is available, by the use of compressor installations. In other areas gas is being piped from near-by fields or gasoline plants, and in some cases it is being purchased from high pressure transmission lines. The second limitation, the problem of low gravity crude is being minimized through the use of the plunger-lift.

Acknowledgments

Grateful acknowledgment is extended to the following individuals whose helpful comments assisted in the preparation of this article: Paul Mills and Harry Eicher, Camco, Inc.; R. W. Bond, Shell Oil Company; C. D. Fletcher, Merla Sales and Service; Vaughn Freeborn, Crown Central Petroleum Company; Jack Kinley, M. M. Kinley Company; Robert Kuns, McEvoy Company; E. D. McMurry, Garrett Oil Tool Company; Bill Middleton, Floy L. Korsten Company; Douglas Ragland, Humble Oil and Refining Company. * * *

Executives of the Petroleum Division of ASME. Attending the recent annual meeting of the American Society of Mechanical Engineers in New Orleans, Louisiana, are: Seated, D. P. Thornton, Petroleum Processing, chairman of the press and publicity committee; E. W. Jacobson, Gulf Research and Development Company, chairman of the executive committee; J. M. Sexton, M. W. Kellogg, secretary of the executive committee; H. J. Voorhies, Esso Standard Oil, speaker at the meeting, and P. E. Frank, Sinclair Refining, chairman of the refining committees. Standing, O. L. Lewis, C. F. Braun and Company, publicity secretary; F. J. Daasch, Gulf Oil Corporation, chairman of the membership committee; F. H. Warren, Ohio Oil Company, chairman of the transportation committee, and O. B. Schier II, ASME meetings manager.

ASME Luncheon Speakers and Guests. J. M. Sexton, M. W. Kellogg Company; James M. Todd, James M. Todd and Associates; Hon. deLesseps S. Morrison, mayor of New Orleans; Waldemar S. Nelson, Bedell and Nelson, and H. J. Voorhies, general manager, Baton Rouge Refinery, Esso Standard Oil Company, addressing session, are shown at the American Society of Mechanical Engineers' annual meeting in New Orleans, Louisiana.

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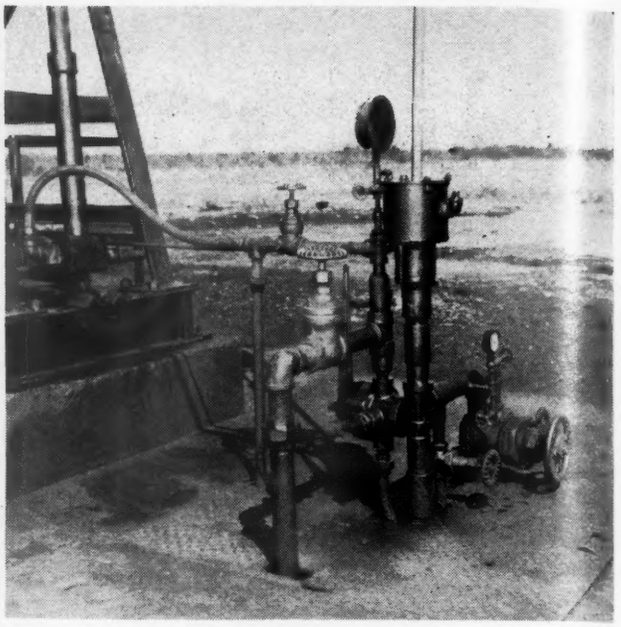

A parallel string paraffin control installation on a well in the Foster field of Ector County, Texas, shows the operator (left) connecting the hydraulic pump to the walking beam preparatory to pumping a soluble plug down the 1-in. macaroni string through which the well produces above the crossover at 1275 ft. The close-up view (right) shows the soluble plug injector valve connected to the top of the 1-in. tubing, the flow-line connection, the oil supply line from the 65-gal supply tank (left), and the by-pass line from the supply line entering the cellar where it is connected to the main 2-in. tubing string.

Paraffin Control System Uses Parallel Strings

K. MARSHALL FAGIN*

A "PARALLEL-STRING" paraffin control system has been designed for installation on oil wells that are troubled with heavy accumulations of paraffin in the upper part of the tubing string and the lead lines. The system employs a string of 1-in. tubing that is joined to the main tubing string at a place below which paraffin deposits are not found. The macaroni tubing is run in the well simultaneously with the main string after being joined to the main string through a special cross-over tee. The macaroni string is clamped to the main string about every 100 ft as the two strings are run together in parallel, and the 1-in. tubing emerges beside the main string at the wellhead as may be seen in the accompanying photos.

Although the first installation of the parallel string system was made last March on a pumping well in the Foster field of Ector County, Texas, the system may be adapted for service on gas-lift or flowing wells that are troubled with paraffin deposition.

A plug injector valve is installed on the 1-in. string, and the flow line is connected to the top of the injector valve. A supply tank with a capacity of about 65 gal of crude oil is connected to the flow line above the injector valve. A by-pass line from the oil supply line is run down through the cellar floor cover and connected to the main tubing string. This by-pass line can be used for reverse pumping of the soluble plug, if it should become lodged in the macaroni string.

A simple hydraulic pump is mounted in front of the Sampson post and is operated when injecting a soluble plug by the walking beam on pumping wells as shown in the photos.

A pumping well equipped with the parallel string system of paraffin control is pumped normally through the 1-in. tubing string. The upper portion of the main tubing string is thus closed off, so that little paraffin is ever deposited in it unless the fluid level changes frequently. Continuous operation of such a well is therefore desirable, and should result in a fairly stable fluid level in the main tubing and deposition of paraffin in the 1-in. string.

A 1-in. soluble plug is then injected periodically through the injector plug valve and pumped down the 1-in. tubing by the hydraulic pump. After the plug is through the paraffin that may have been deposited in the 1-in., the supply line going to the 1-in. is shut off, and the by-pass is opened into the main tubing string. Oil is pumped into the main tubing string while the bottomhole pump is operating. The soluble plug is thus pumped back out of the 1-in. into the flow line, where it dissolves in a few hours. The oil used to pump the plug down the 1-in. is returned to the supply tank while the plug is being circulated out.

The installation shown in the photos has been in operation since March, 1950, and has been pumping about 13 bbl of oil per day with almost no trouble from paraffin. A soluble plug has been injected about every 3 days by the operator. The 1-in. tubing was connected to the 2-in. main tubing string at a depth of about 1275 ft. When the bottomhole pump was pulled in June for repair, the rods had no paraffin accumulation down to 1275 ft and only a very thin coat of paraffin from 1275 to 1800 ft. Below 1800 ft, the rods were almost free from any paraffin deposits. The cost of installation on the well shown is reported to be about $925, including all materials. The additional operating cost is about $1.25 per month for the soluble plugs.

* * *

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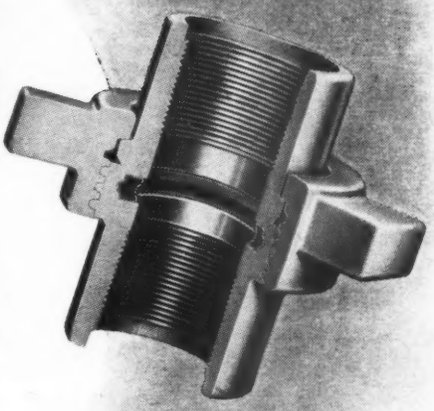

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FIG. 1.

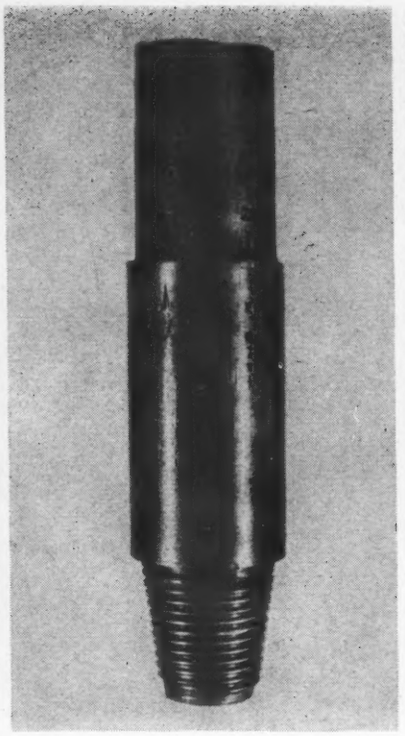
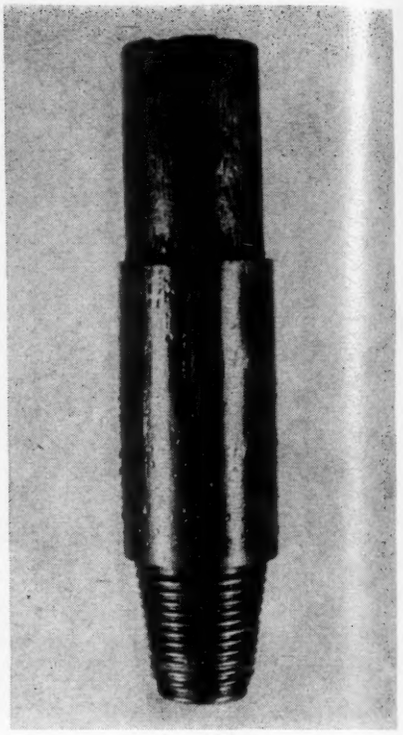


FIG. 2. A



B

Effect of Oil Emulsion Mud on Drilling†

JOHN P. WEICHERT* and ORIEN W. VAN DYKE‡

Oil emulsion mud has been attracting attention for a wide variety of drilling uses. It is not surprising because some rather outstanding accomplishments have been attributed to the presence of emulsified oil in the drilling mud. The drilling rate of some formations has been doubled; bit life and time on bottom have been increased; rotating torque, pipe drag, and circulating pressure reduced. The high degree of hole lubrication provided by this mud has made possible the trouble-free drilling of high angle directional holes, completion of difficult fishing jobs and the drilling of troublesome sloughing shale zones. Tight low pressure sands drilled with emulsion mud have proved to be much more productive than similar wells drilled with conventional mud.

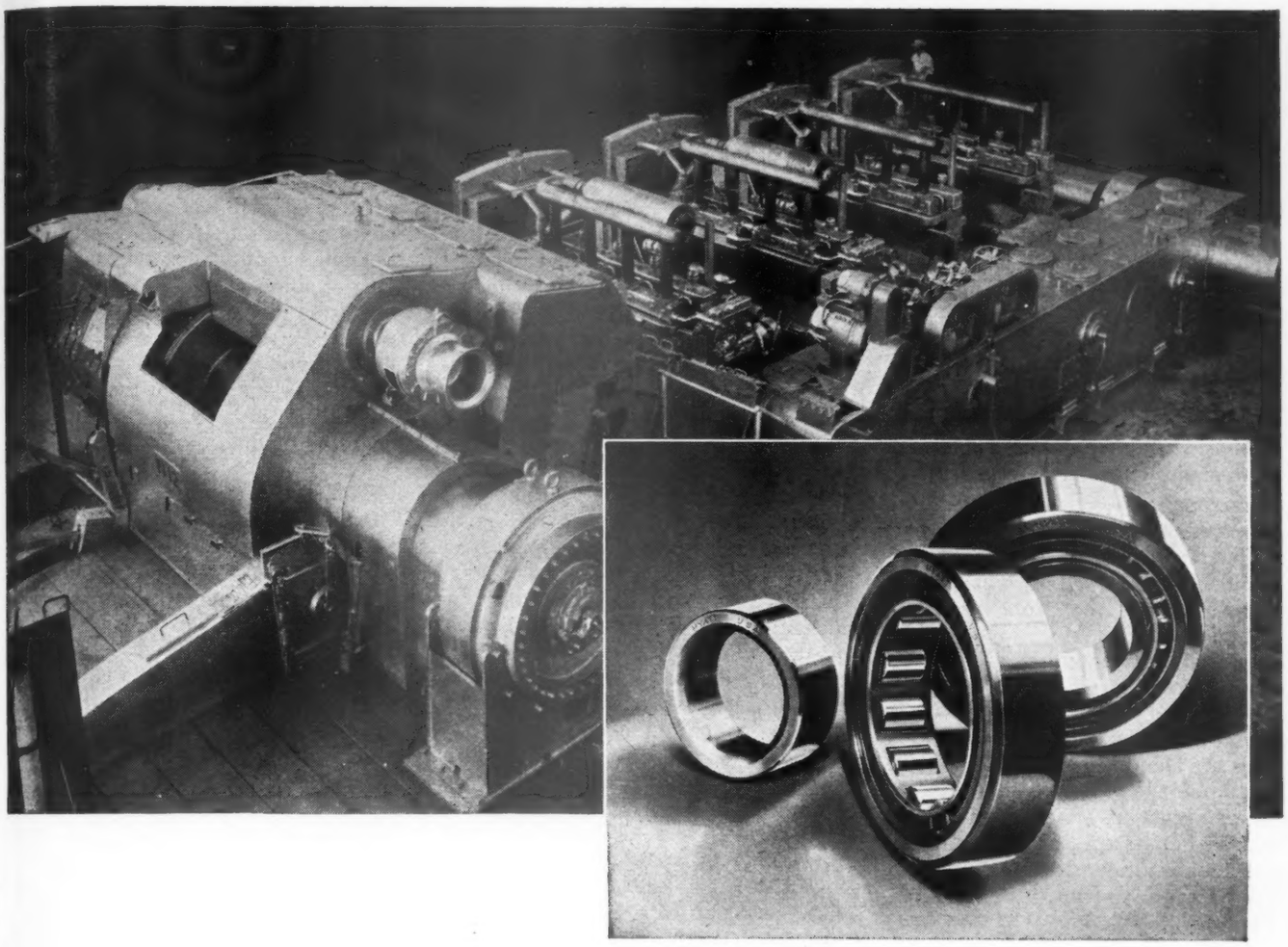
It is interesting that these advantages can be obtained using a mud that has the same appearance and general behavior of an ordinary water base mud. Oil emulsion muds require no special methods of use or special rig equipment. They do not interfere with the examination of cuttings or cores, and electric logs are perfectly normal. Last, but not of least importance, the added cost of making up an emulsion mud is low—normally between one and two dollars per barrel depending upon the oil content.

A brief discussion of oil emulsion theory will be helpful in explaining what emulsion muds are and how they behave. An emulsion is an intimate mixture of two immiscible liquids, one being dispersed in the other in the form of fine droplets. Mixtures of oil and water form two types of emulsions—the "water-in-oil" type in which the water is dispersed in the form of droplets in a continuous phase of oil, and the "oil-in-water" type in which the oil is dispersed in the form of droplets in a continuous phase of water. The emulsion muds being discussed are "oil-in-water" type emulsions. If a mixture of oil and water is violently agitated, an emulsion is formed, however, upon standing, the droplets of oil will coalesce and the two liquids separate into layers unless an emulsifying agent is present. The functions of an emulsifying agent are to reduce the interfacial tension between the water and the oil, and to form a protecting film around the droplets so that they will not reunite. The stability and other properties of an emulsion are dependent upon the kind and type of emulsifying agents used. There are two general types of

†Presented at the tenth annual meeting of American Association of Oilwell Drilling Contractors, at Tulsa, Oklahoma, October 9-10, 1950.

*District petroleum engineer, Gulf Oil Corporation, Houston, Texas.

‡Vice president, Magnet Cove Barium Corporation, Houston, Texas.



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emulsifying agents—the chemical or soluble organic type, and the solid or mechanical type. The chemical emulsifiers are compounds whose molecule is made up of a portion that has an affinity for oil, and a portion that has an affinity for water, with the result that it concentrates at the oil water interface forming a stabilizing film around the droplets. Finely dispersed solids which are insoluble in both phases may act as an emulsifier by forming a mechanically strong film around the droplets which discourages coalescence. The oil globules in an emulsion prepared with a chemical emulsifier are much more stable than those made with a solid emulsifier.

There are thousands of emulsifying agents, each suitable for making a particular type of emulsion or imparting specific properties. In preparing oil emulsion muds the problem is not that of simply making an emulsion, but it is the combining of oil with mud so as to produce an improved drilling fluid. This should not be interpreted to indicate that emulsion muds are complicated as they are not, but to point out that the oil and emulsifying agents are added to water base mud to impart specific properties so that the resulting drilling fluid will better serve its intended use.

Emulsion muds may be prepared by adding 5 to 20 per cent by volume of oil containing an emulsifying agent, to any type of drilling mud. It is the usual practice to add the oil slowly to the pump suction while drilling is in progress, so that it is evenly distributed in the mud system over one or two cycles of circulation. Prior to adding oil to a system of mud, pilot samples should be prepared to determine the results to be expected. In general emulsion muds have the same behavior, and are treated in the same manner as the base muds from which they were prepared.

A variety of types of emulsion muds are in general use. In some cases only crude oil, fuel oil, or diesel oil is added to the mud, forming a mechanical emulsion, which is stabilized by the finely dispersed solids in the mud. Diesel oil has been added to lime-starch muds, both with and without lignitic chemicals to aid in stabilizing the emulsion. Oil blends containing a chemical type emulsifying agent made especially for preparing emulsion muds are also being used. The merits of each type of emulsion mud are somewhat controversial and should probably be left to the discretion of the individual operator. It can be stated that oil alone does improve the lubricating properties of most muds. however, the stability of the resulting emulsion muds and the performance characteristics that have been observed, appear to be dependent upon the emulsifiers used.

Fig. No. 1 is a photomicrograph taken at 900 magnifications of an "oil-in-water" emulsion containing 2 per cent jet-oil "e", such as is used in mud. Note that the oil is dispersed in the form of stable droplets. The larger globules of oil in this picture have a diameter of approximately one ten thousandth of an inch. Their minute size can be better visualized by pointing out that one pint of oil emulsified in this manner will yield 400,000 billion individual droplets. We believe that it is these tiny globules of oil that account for the difference in the performance characteristics of an emulsion mud, and the water base mud from which it was prepared. The stabilized droplets of oil are thought to be dispersed in the mud in the same way as the colloidal clay solids. We are all familiar with the slickness or lubricating properties that a colloidal clay such as bentonite imparts to water, so it should not be difficult to visualize the improved lubricating effect resulting from tiny balls of oil in such a suspension. It is not improbable that the highly dispersed oil droplets act like ball bearings between the plate-like clay particles, resulting in decreased friction. This is thought to account for the decreased circulating pressures and the better lubricating properties of an emulsion mud.

The reduction in water loss characteristics of a mud resulting from the addition of emulsified oil is thought to be explained by the plugging action of the stable oil droplets as they are forced into the capillary channels of the mud filter cake as filtration proceeds. This is confirmed by the fact that the filtrate of a good emulsion mud is clear water.

One of the most important properties that has been observed of emulsion mud containing a chemical type emulsifier is its ability to perferentially wet steel surfaces with a film of oil. Fig. No. 2 is a picture of two tool joints.

In picture A, the surface of the steel is wet with a uniform film of water. In picture B, the surface of the steel is coated with a film of oil. Note the water is in the form of large drops that shows that a water film will not adhere to an oil wet surface. This oil film on the steel appears to prevent water wet shale from sticking to the drill pipe, drill collars, and cutting edges of the bit. It is interesting that this oil coating of the metal occurs only at points of intense rubbing, such as on the pipe and drill collars in the open hole, so it appears to be caused by a rupture of the oil globules resulting in a smearing of the emulsifier and oil on the metal surface forming an oil film that is not displaced by water.

The three principal properties contributed by emulsified oil: 1. Lubrication, 2. sealing of the wall cake, 3. oil coating of the steel—appear to have a decided effect upon the performance of a drilling fluid in getting the job of drilling accomplished.

Early in 1949 the Gulf Oil Corporation conducted a field test to determine the effect of oil emulsion mud upon drilling rate, life of bits and other bore problems. The section 28 field, St. Martin Parish, Louisiana was selected because of the low rates of penetration and the large number of rock bits required. The holes compared were geologically on strike, drilled by the same rig and same crews. In both cases 9⅞ in. rock bits were used with the same number of drill collars, the same weight on the bit and, in general, all conditions were kept the same. The same type of 10.7 lb per gal lightly treated phosphate mud was used, except for the maintenance of 11 to 17 per cent by volume emulsified oil in the test mud. The results are shown in Table 1.

In view of the favorable results of the section 28 field test the Gulf Company tried emulsion mud at other locations in the Gulf Coast of Louisiana and Texas. Table 2 shows the results obtained in the Bully Camp Field, La Fourche Parish, Louisiana. Fifteen per cent oil emulsion was added to the 15.2 lb per gal lime-starch mud while drilling at 9008 ft. Drilling data is shown for the 500-ft interval before

(Continued on page B-35)

Table 1.

Well	Section drilled	Footage	Bits used	Ft/bit	Rotating hours	Bit life hours	Drilling rate ft/hr
"A" Water Mud	9428—10,423	995	15	66.3	480.5	32	2.07
"B" 11–17 per cent Oil Emulsion	9420—10,429	1009	8	126.1	416.0	52.1	2.43

Summary of results

1. Saved 7 bits and trips — a reduction of 46.6 per cent.
2. Saved 64.5 rotating hours — 13.4 per cent.
3. Increased bit life 20.1 hours — 62.8 per cent.
4. Increased footage per bit — 59.8 ft — 90.5 per cent.
5. Increased drilling rate 0.36 ft/hr — 17.4 per cent.

(Continued from page B-18)

and after adding the oil. Eight and a half inch rock bits were used and other conditions remained the same. Examination of the cuttings and other geological information indicated the formation in the sections compared was the same.

Table 3 shows drilling data for two similar wells in the Hull field, Liberty County, Texas. Except for the maintenance of 10 per cent emulsified oil in the mud of well "B", the same type of lime-starch mud (weight 10 lb per gal to 14 lb per gal) was used for both operations. Both wells were drilled with the same practice and equipment using 9⅞ in. rock bits.

A comparison of offset wells in the South Gillock field, Galveston County, Texas, is shown in Table 4. These holes were drilled by the same rig, the same crews and following the same general practices. Both wells had 11¼ in. surface casing set at approximately 1330 ft and carried 10⅝ in. open hole below this depth. A lime-starch mud (weight 12 lb per gal to 13 lb per gal) was used in both cases, the only difference being the mud in well "B" contained 10 per cent emulsified oil, which resulted in an average water loss of 2.5 cc compared to 4.6 cc for the mud in well "A".

Oil emulsion mud has had limited use recently in the hard rock drilling of West Texas. Table 5 compares three wells drilled in the Yarborough-Allen Field located west of Odessa, Texas. The comparison covers the drilling of the Devonian and Silurian Chert sections and some shale sections. Well "A" used a lightly treated bentonite mud, well "B" a salt water-starch mud and well "C" a lightly treated bentonite mud containing 5 per cent emulsified oil.

Tables 6, 7 and 8 contain data obtained from recent tests conducted in the Pegasus field situated south of Odessa, Texas.

Table 6 compares two wells drilled with a lightly treated bentonite mud and one drilled with a similar mud containing 10 per cent emulsified oil. The formation in the interval covered was predominantly hard shale and lime.

Table 7 shows a comparison of two holes drilled through a section of hard lime and shale. The mud used in both cases was similar except for the addition of the oil emulsion to mud "B".

Table 8 covers the drilling of the Devonian section that consists of hard lime containing varying concentrations of chert. The drilling operations were similar except for the mud used in well "B" containing emulsified oil.

In Stephens County, Oklahoma, a

Table 2.

Type Mud	Section drilled	Footage	Bits used	Ft/bit	Rotating hours	Bit life hours	Drilling rate ft/hr
Water Mud	8503—9000	497	7	71	200	28.6	2.49
12-15 per cent Oil Emulsion	9008—9500	492	2	246	87	43.5	5.66

Summary of results

1. Saved 5 bits and trips — a reduction of 71.5 per cent.
2. Saved 113 rotating hours — 56.5 per cent.
3. Increased bit life 14.9 hr — 52 per cent.
4. Increased footage per bit — 175 ft — 246 per cent.
5. Increased drilling rate 3.17 ft/hr — 127.2 per cent.

Table 3.

Well	Section drilled	Footage	Bits used	Ft/bit	Rotating hours	Bit life hours	Drilling rate ft/hr
"A" Water Mud	5067—6722	1655	5	331	149	29.8	11.1
"B" 9-11 per cent Oil Emulsion	5067—6722	1655	4	414	118	29.5	14.0

Summary of results

1. Saved 1 bit and trip — a reduction of 20 per cent.
2. Saved 31 rotating hours — 20.8 per cent.
3. Increased footage per bit — 83 ft — 25 per cent.
4. Increased drilling rate 2.9 ft/hr — 26.1 per cent.

Table 4.

Well	Section drilled	Footage	Bits used	Ft/bit	Rotating hours	Bit life hours	Drilling rate ft/hr	Total days
"A" Water Mud	9632—11,467	1835	29	63.3	384.25	13.26	4.77	28
"B" 10 per cent Oil Emulsion	9586—11,439	1853	19	97.6	341.25	17.96	5.44	22

Summary of results

1. Saved 10 bits and 10 trips — a reduction of 34.5 per cent.
2. Saved 43 rotating hours — 11.2 per cent.
3. Increased bit life 4.7 hours — 35.5 per cent.
4. Increased footage per bit 34.4 ft — 54.3 per cent.
5. Increased drilling rate 0.67 ft/hr — 14 per cent.
6. Saved 6 days in total time — 21.4 per cent.

Table 5.

Well	Section drilled	Footage	Bits used	Ft/bit	Rotating hours	Bit life hours	Drilling rate ft/hr
"A" Water Mud	8011—9157	1146	42	27.3	421.00	10.02	2.72
"B" Salt Water Starch	7987—9149	1162	50	23.2	467.50	9.35	2.49
"C" 5 per cent Oil Emulsion	8022—9217	1195	50	23.9	365.25	7.3	3.28

Summary of results

1. No savings in number of bits or trips.
2. Saved 56 rotating hours — 13.3 per cent.
3. No increase in bit life or bit footage, actually a decrease.
4. Increased drilling rate 0.56 ft/hr — 20.6 per cent compared to water mud, and 0.79 ft/hr — 31.7 per cent compared to salt water-starch mud.

Table 6.

Well	Section drilled	Footage	Bits used	Ft/bit	Rotating hours	Bit life hours	Drilling rate ft/hr
"A" Water Mud	9995—11,281	1286	28	46	293.75	10.5	4.38
"B" Water Mud	9967—11,205	1238	24	51.5	272.25	11.36	4.53
"C" 10 per cent Oil Emulsion	10,001—11,280	1279	24	53.3	214.75	8.95	5.94

Summary of results

1. A reduction in rotating hours and increased footage per bit.
2. Increased drilling rate 1.41 ft/hr — 31.1 per cent.

Table 7.

Well	Section drilled	Footage	Bits used	Ft/bit	Rotating hours	Bit life hours	Drilling rate ft/hr
"A" Water Mud	10,481—11,574	1093	20	54.6	238.75	11.95	4.58
"B" 5 per cent Oil Emulsion	10,480—11,578	1098	18	61.0	227.00	12.60	4.84

Summary of results

1. Saved 2 bits and trips — a reduction of 10 per cent.
2. Saved 11.75 rotating hours — 4.92 per cent.
3. Increased bit life 0.65 hr or 5.44 per cent.
4. Increased footage per bit — 6.4 ft — 11.7 per cent.
5. Increased drilling rate 0.26 ft/hr or 5.68 per cent.

Table 8.

Well	Section drilled	Footage	Bits used	Ft/bit	Rotating hours	Bit life hours	Drilling rate ft/hr
"A" Water Mud.....	11,241—12,353	1112	69	16.15	375.25	5.44	2.97
"B" 7–10 per cent Oil Emulsion..	11,281—12,372	1091	52	21.00	340.00	6.55	3.22

Well "A"— 3 bits pulled for drill stem test.
Well "B"— 5 bits pulled for drill stem test.

Summary of results

1. Saved 17 bits and trips — a reduction of 29.6 per cent.
2. Saved 35 rotating hours — 9.35 per cent.
3. Increased bit life 1.11 hr — 20.4 per cent.
4. Increased footage per bit — 4.85 ft — 30 per cent.
5. Increased drilling rate 0.25 ft/nr — 8.4 per cent.
6. Greatest improvement in bit life and drilling rate were noted in sections containing chert.

large number of 3000 ft wells have been drilled with emulsion mud, primarily to improve productivity and reduce completion time. It has been observed that upon the addition of the oil to the mud, the drilling rate increased immediately. Numerous cases have been reported showing increases of 100 per cent to 200 per cent in the drilling rate, and a reduction of 30 per cent to 50 per cent in the number of bits used.

A recent well in Lincoln County, Oklahoma, was drilled from 2008 ft to 3115 ft with a lightly treated natural mud containing 16.5 per cent by volume emulsified oil. Upon the addition of the oil, the drilling rate increased from 9.24 ft/hr to 24 ft/hr, or 160 per cent. A comparison with the offset well showed this 1107 ft section of hole was drilled with two less bits and with a savings in total time of two days.

The advantages of emulsion mud in the drilling of directional holes is very apparent because of the large reduction in rotating torque and pipe drag, resulting from the lubricating properties of the emulsified oil. It is thought that there has been an improvement in the drilling rate in most every directional hole that has used emulsion mud; however, comparisons are difficult because of the varying conditions in such operations. Two examples will be cited.

1. A well located in the Gulf of Mexico, 25 miles south of Cameron, Louisiana, was drilling at approximately 6550 in a 28 deg hole. The addition of 10 per cent oil emulsion to the 10 lb per gal natural mud resulted in reducing the torque from 25 to 15 on the indicating gage, pipe drag from 55,000 lb to 10,000 lb and increased the drilling rate from 5 ft/hr to 7 ft/hr.

2. A comparison of two directional holes drilled in the Lake St. John field, Concordia Parish, Louisiana, showed that the drilling time for 3360 ft of hole between 5000 ft and 8360 ft was reduced from 22 days to 15 days by the maintenance of 12 to 18 per cent emulsified oil in the mud.

Why does the introduction of oil into a drilling fluid increase the rate of drilling and the life of bits? We believe several factors contribute:

1. Reduction of torque and hole friction so that the actual weight on the bit is more accurately shown by the weight indicator.

2. The oil wetting of the steel prevents the balling or clogging of the teeth or blades of the bit so that a new penetration or cut or virgin formation is made with each rotation of the bit.

3. The oil coating of the steel increases bit life by improving the lubrication of the bearings and decreasing the formational wear on the teeth and blades of the bit.

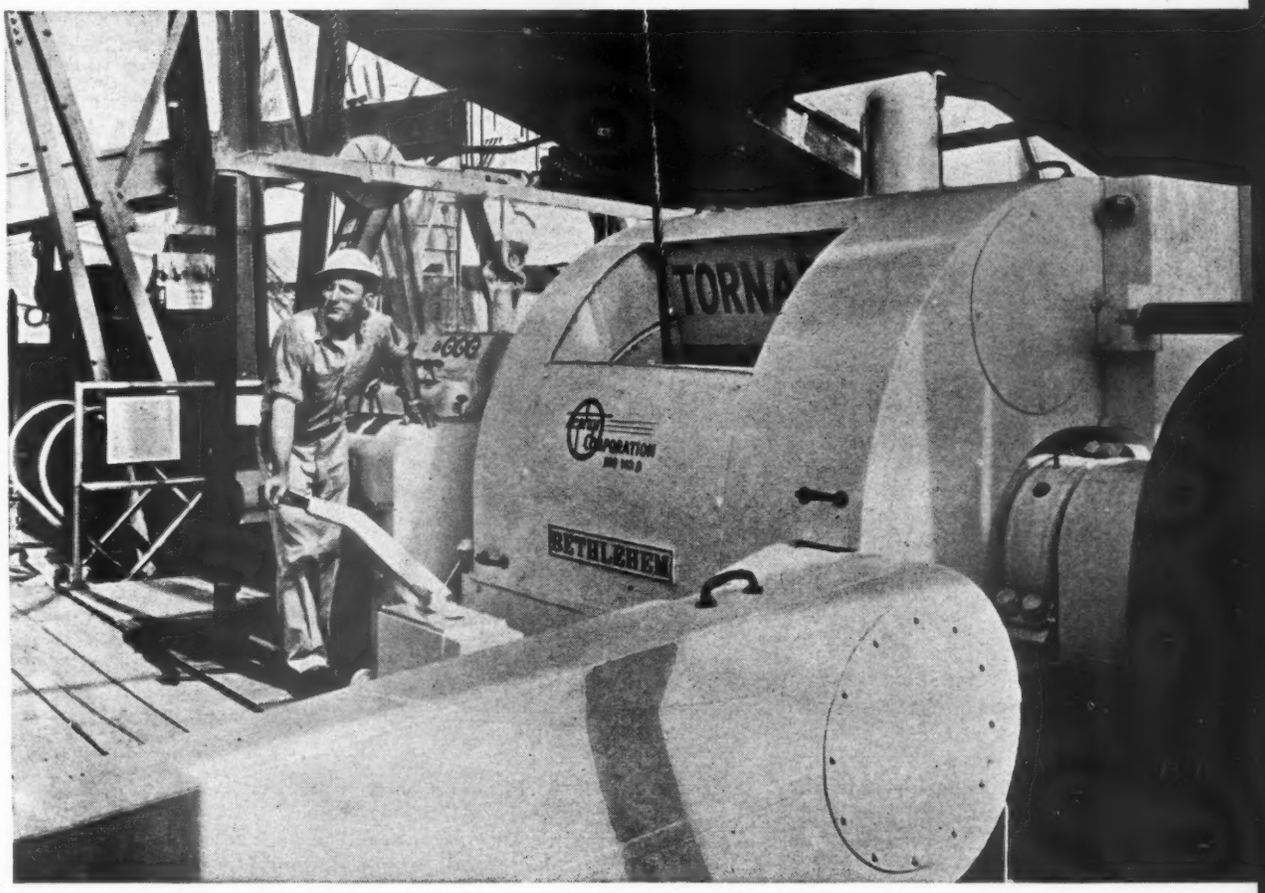
So far in this discussion it has been shown that emulsion mud definitely influences the rate of drilling and the life of bits. These factors are very important but there are other problems related to drilling which at times may assume proportions to become even more important. Drilling rate or bit life means little during times when a hole is giving trouble due to sloughing shale, severe balling, and other causes which result in lost time and sometimes stuck drill pipe. Emulsion mud is not a cure-all but experience has shown it to be very helpful in handling a variety of troublesome hole problems.

Numerous cases of sloughing shale trouble have been corrected by the use of emulsion mud. It is thought that this can be attributed to the low filtration properties of emulsion mud and the sealing of the walls of the hole by the droplets of oil which retard water soaking of the formations drilled. Caliper logs were run in two similar holes drilled in the Goose Creek field, Harris County, Texas. Well "A" was drilled with a lightly treated natural mud and well "B" was drilled with the same type of mud containing 12 per cent emulsified oil. The protecting effect of the emulsion mud was shown by the bit-sized hole in well "B", whereas hole "A" was

FIG. 3.

A B C

How can a BIG rig be so smooth?



That's a common question among drillers who know the Bethlehem Tornado. It's big, all right; a burly, deep-drilling giant with power to burn. Sturdy isn't the word—it's rock-rugged. Yet it is smoother, easier to handle, than many a smaller unit.

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A B

FIG. 4.

considerably enlarged. It is probable that the factors contributing to hole enlargement are often the cause of sloughing shale troubles.

The balling of shale on the bit, drill collars, and pipe, at times presents a very severe drilling problem. It may cause the loss of considerable time due to spudding and reaming and in extreme cases, sticking of the drill pipe. Shale balling also results in a restriction of the annulus which in some cases is a major contributing factor to the loss of circulation. We have observed that the oil coating of steel surfaces by emulsion muds prepared with a chemical type emulsifier such as modified tall oil soap, greatly retards, and in some cases, eliminates balling. Experience on several recent wells will be reviewed in the order of their occurrance.

Severe balling was experienced in a well in the Pierce Junction field, Harris County, Texas while drilling at about 8000 ft with a 15.5 lb per gal mud. Because of previous trouble in this area 15 per cent diesel oil was added to the lime starch mud forming what we have referred to as a mechanical type emulsion. The balling was so severe, it finally resulted in sticking of the drill pipe. It was decided to convert the mud to a chemical type emulsion because of its ability to oil coat the pipe. The hole was sidetracked and drilled through the same section to a total depth, 1600 ft below that which the pipe stuck. This was accomplished with only occasional balling on the walls of hole and with none of the drill collars or pipe.

A similar problem was encountered in a well near Sinton, Texas. Seven and five-eighth inch casing had been set at approximately 7600 ft and a 6⅝ in. hole drilled in very soft sticky shale to 8327 ft with extreme difficulty using a 16.5 lb gal lime starch mud containing 7 to 15 per cent diesel oil. At this depth progress had virtually come to a stop due to severe balling of the pipe, drill collars and hole. An attempt to run an electric log failed, and following trips it was necessary to start reaming less than 100 ft below the casing.

Picture "A" of Fig. 3 shows the balled bit and drill collar pulled after reaming to 8200 ft, in an unsuccessful attempt to get to bottom. There was no evidence of an oil film on the drill collars or pipe. Thirty-seven barrels of oil containing a chemical type emulsifier were added to the mud following the trip mentioned, while reaming at 8000 ft. An improvement was noticed by the driller almost immediately. The hole was reamed to bottom in five hours, then drilled to 8339 ft, and a test trip to the casing made without trouble. Picture "B" shows compacted balled shale that was circulated out of the hole while working the pipe after reaming to bottom. Picture "C" shows the bit and drill collar as it was pulled from the hole on the trip following picture "A". There was noticeable film of oil on the drill collars and pipe, which is thought to have eliminated the balling. An electric log was run to bottom and 5½ in. liner cemented on bottom without further difficulty.

☆ ☆ ☆

At Oklahoma's deepest test in Ellis County, Sunray Oil Corporation is drilling below 13,943 ft in lime. The No. 1 Hanan is scheduled to drill to 15,000 ft.

The two pictures in Fig. 4 show the severe balling that has been experienced in drilling the soft heaving shale zone in the Peach Point field, Brazoria County, Texas, with silicate-brine mud. In picture "A" the ball on the drill collar is as large as the bit. The drill pipe in the background shows evidence of the balled shale (which has been scraped off) that formed above practically every tool joint in the open hole and occasionally above tool joints running in the casing. Balling such as this has been a serious problem in the 3 previous holes drilled in this field. In view of the success in preventing shale balling in wells at Pierce Junction and Sinton, 10 per cent by volume oil containing a chemical emulsifying agent was added to the 14.5 lb per gal silicate-brine mud at 7452 ft in the well now drilling. Fifteen hundred feet of hole was drilled with no balling and during the next 1500 ft, where the drilling rate was twice that of previous wells, there was 8 per cent to 10 per cent thin, spotted balling of the drill collars. No balling occurred on the drill pipe. The oil film on the pipe and drill collars is thought to have prevented the balling. The virtual elimination of balling in this well reduced the drilling time for this 3000 ft interval, 9 days, saved 8 bits and trips and $10,000.00 in mud costs.

Experience to date indicates that oil emulsion mud does have a definite effect upon drilling. It appears to offer added insurance against trouble and a means of speeding up the drilling operation. We believe the usefulness of this new tool will be multiplied many times as our knowledge of emulsion muds is enlarged.

The authors would like to express appreciation to the Gulf Oil Corporation, The Superior Oil Company and the Magnolia Petroleum Company for well information that made this paper possible.

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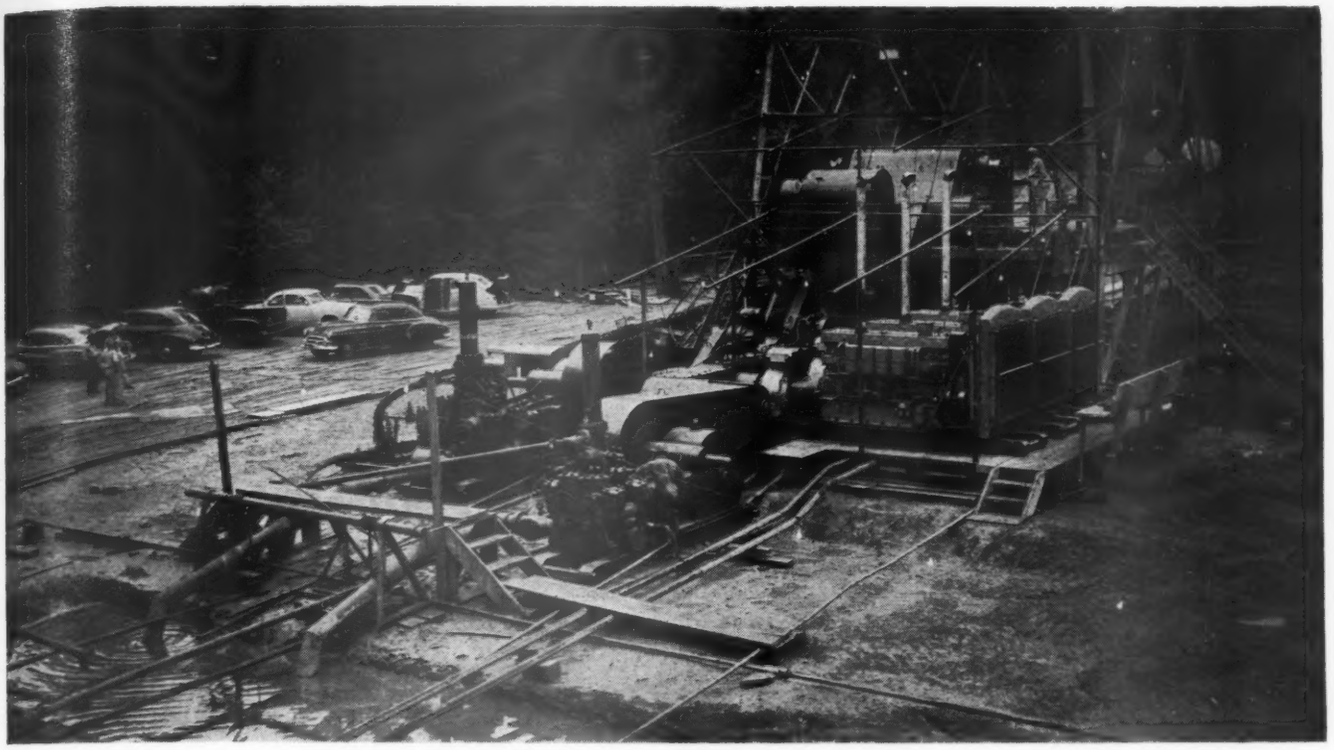

Fig. 1. Rex Drilling Company's new rig in the Tinsley Field of Yazoo County, Mississippi, is the first one in the world ever equipped with electro-magnetic, eddy-current type couplings. It is now drilling below 6000 ft on a 12,500 ft deep test. The 550-hp Dynamatic couplings are installed between the 450-hp diesel engines and the compound transmission.

First Rig Equipped With Dynamatic Couplings Being Used on Deep Test

K. MARSHALL FAGIN*

ALTHOUGH Dynamatic couplings[1] have been used for years on various machines ranging from fractional horsepower units for Ditto machines to 18,000 hp models for wind tunnels, the first application of these electro-magnetic, eddy-current couplings has just been made on a rotary drilling rig. The rig is owned by the Rex Drilling Company of Shreveport, Louisiana and is now drilling below 6000 ft on a deep test in the Tinsley field of Yazoo County, Mississippi, which is projected to 12,500 ft.

Three of these couplings are installed on a new 3-engine, 6-speed, air-controlled rig.[2] The couplings are cooled by the circulation of about 20 gal of water per minute. They are installed between the 450 hp diesel engines[3] and the compound transmission, and are connected directly to Fast's flexible couplings on either side (see Fig. 2). The Dynamatic couplings are designed to transmit 550 hp at 1000 rpm compared with the engine rating of 450 hp at full-governed speed of 900 rpm.

Each coupling has its own generator for d-c current for exciting the electro-magnetic field. Should one of these generators fail, however, provision is made for switching over to the rig lighting system for excitation of the electric coils in the coupling. In the event of total electric failure, there are emergency locking pins in the couplings that can be inserted by the crew for positive power transmission. The exciters, couplings, and controls are explosion proofed.

Other equipment on the rig includes an 8 by 20-in. slush pump;[4] a 7¾ by 16-in. slush pump;[4] two 4½ by 6-in. general service and washdown pumps;[4] an auxiliary unit consisting of a 2-cyl diesel,[5] an air compressor,

*Editor, *Drilling and Producing.*

[1]Dynamatic Corporation, Kenosha, Wisconsin.

[2]Emsco J-1250 Rig.

[3]Superior PTDG-8 Diesels with dual fuel injectors and naturally aspirated.

[4]Gardner-Denver Company.

[5]General Motors.

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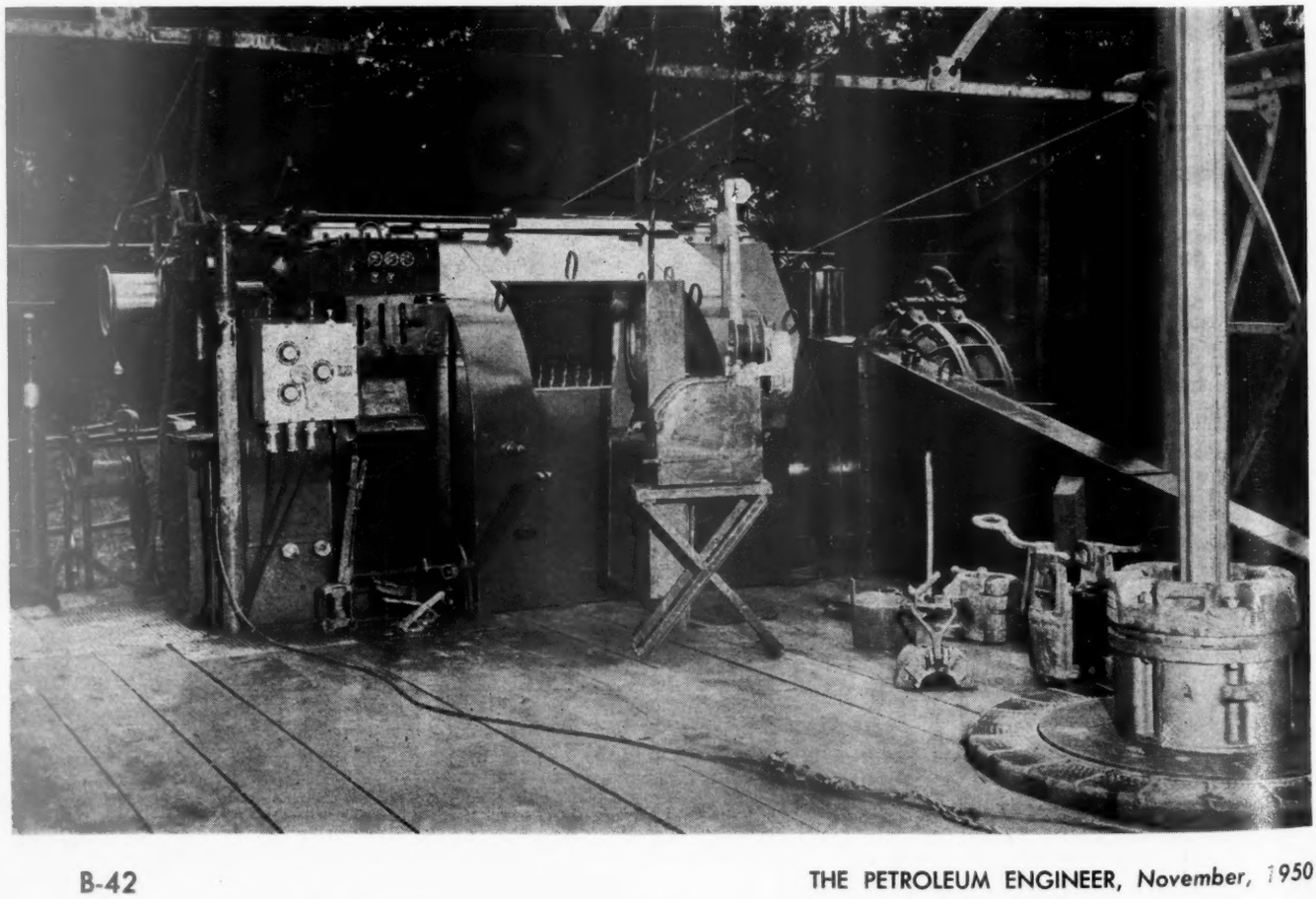
Fig. 2. Each of the three Dynamatic couplings has its own excitation source (the generators mounted on top of the couplings). Current from the rig lighting system can be used to operate a coupling, however, if its own geneartor should fail. The couplings are mounted between two Fast's flexible couplings on the skids that support the 450 hp diesel engines. The 15 kw generator (upper right) supplies current for the rig lighting system when the compound transmission is running.

Fig. 3. The control box for the Dynamatic couplings is mounted on the drawworks at the driller's position. The couplings can be operated individually for each engine by the three outer control knobs, or two or three couplings can be regulated simultaneously by the master control knob in the center, which has a short handle.



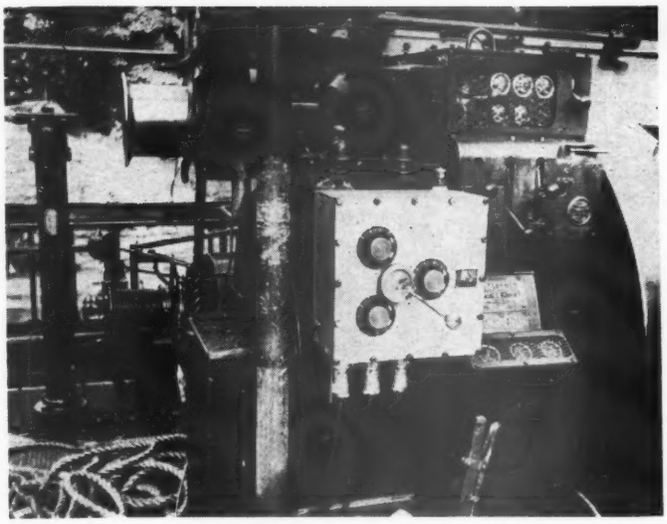


Fig. 4. The Dynamatic couplings are controlled by the rheostat knobs on the control box (center). The outside knobs may be used to control the flow of power from each engine separately. Any combination of engines may be regulated simultaneously, however, by the master control knob in the center, which has a short handle for easy manipulation.

and a 10-kw generator; a 15-kw generator driven from the compound transmission, and an air compressor driven from the compound.

Operation of Rig

Individual rheostats are used to control the Dynamatic couplings on the engines. All engines may be controlled as one, however, by use of the master control switch on the control box at the driller's position (see Figs. 3 and 4). Use of the couplings makes drilling operations on the power rig noticeably smoother and quieter, and adds greatly to the flexibility of operation.

The engines cannot be loaded at idling speed (about 400 rpm), for the couplings will not transmit any torque at idling speed or lower. The driller cannot change that feature of the couplings, however, he can control the speed at which the engines will take the load, which is between about 450 rpm and the full-governed speed of 900 rpm.

When the driller prepares to hoist the drill pipe, he engages the clutch at the idling speed. Then, he advances the throttle and speeds up the engines to pick up the load. If the load is too heavy for the speed in which the rig is set, excessive slip will occur in the coupling, but the engines will not stall. and the heat will dissipate in the cooling water.

This condition can be corrected by shifting to a lower gear. Should the load be light for the gear selected, the hoisting speed can be increased by shifting to a higher gear.

The engines can be run at full-governed speed for hoisting, and the coupling control can be used with the same effect as a steam throttle, that is, it can be opened up until there is enough power to lift the load. In fact, it is now possible to back into the hole with this power rig, if such an emergency should arise, using the engines as brakes.

As the drill pipe is being hoisted, the Dynamatic coupling controls can be manipulated to slow the pipe to a standstill, or even lower it against the engines. This control feature may be used for rotary jarring, or for reciprocating casing in the hole during cementing operations. It is also useful during hoisting operations while spooling new wire line on the drawworks drum, for the drum can be run very slowly while one of the floormen keeps the line spooling properly on the drum.

Pump Speed Control

The coupling controls are also very useful for controlling the slush pump speed during diamond coring operations, which usually call for a decided reduction in the volume of mud circulated, so as to prevent excessive cutting out of the water-courses and premature failure of the diamond bits. The controls can be set actually to stall the slush pumps while holding a predetermined pressure on the mud circulation system. This feature is useful during casing testing operations, or while pumping down a plug during cementing operations.

Use of the coupling controls to regulate the slush pump speed during drilling operations should minimize wear of the pump liners, and thus reduce downtime for liner changes. Should two engines be compounded on the slush pump, the coupling controls can be set so that the maximum safe pressure will not be exceeded, if the pump stalls.

Rotary Table Control

The coupling controls are also useful for regulating the speed of the rotary table. A fundamental characteristic of the couplings is illustrated by the fact that should the drilling bit hang up while drilling, the rotary table will stall when the normal operating torque increases 50 per cent, or to 150 per cent of normal. This characteristic is expected to reduce the number of twistoffs experienced while drilling.

The same characteristic of the couplings applies to the operation of any other machinery such as the slush pumps, that is, the machinery will stall and the coupling will slip whenever the loads exceeds 150 per cent of normal. The driller, of course, can change the setting of the controls and apply more power to a job, if it is available, however, he is warned automatically that operating conditions have changed.

* * *

Phillips Output Greater

Net crude oil production of Phillips Petroleum Company, including its domestic and foreign subsidiaries, is currently 112,000 bbl per day, according to K. S. Adams, president. This compares with 93,600 net barrels of crude oil produced daily a year ago. Adams further reported that the company presently has a greater number of drilling operations with 140 gross wells and 95 net wells this year as compared with 53 gross and 33 net wells on this date in 1949. Contributing heavily towards this increased production, or showing promise for future production, are a number of developments in West Texas.

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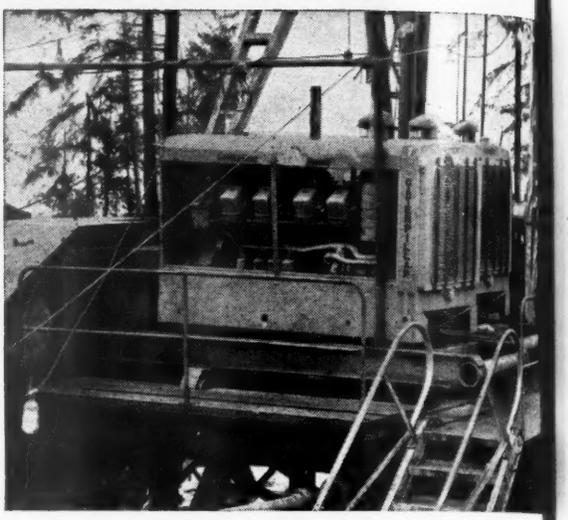

These "Cat" Diesel D17000 Oilfield Engines, compounded, provide power for hoist, rotary table and mud pump on this "National 50" rig on Graham Island.

Dependable "Cat" power (the D311 Electric Set) for lights, washdown pump, water well pump and auxiliary motors at Graham Island.

WHEN the Royalite Oil Co., Ltd., of Calgary, Alberta, put down its structural test well on Graham Island, B. C., they didn't gamble on the power for the job. By standardizing on "Caterpillar" Engines and equipment, Royalite Oil made certain that making hole would be an efficient operation. With the over-all risk entailed in sinking this test well to 3,512 ft. hundreds of miles from home base, there could be no *wildcatting* on choice of power.

A "National 50" rig was moved from Hobbema, Alberta, to Graham Island—the last of the run by coastal vessel. The rig was powered by two "Cat" Diesel D17000 Oilfield Engines, compounded to deliver up to 380 HP. for hoisting under maximum conditions. A "Cat" D311 Electric Set handled the doghouse assignment, furnishing power for lights, miscellaneous motors, the washdown pump and water well pump. Both "Cat" Oilfield Engines and Electric Set stood up and delivered, "giving satisfactory service with a minimum of repairs."

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Care and Maintenance of Slush Pumps†

W. J. REDMAN*

MUCH has been said and written about how to select suitable pumps and prime movers for oil well drilling. There is no mystery about the many factors that determine the mud volume and pressure required. The main consideration is that the equipment selected shall be neither too small nor too large for the contemplated drilling operations. If it is too small, parts will be overstressed and bearings will be overloaded, decreasing their life. It will be a constant burden to the owner, requiring frequent expenditures of money for parts and service to keep it in operation. If it is too large, it is heavier and more expensive to move and represents excessive capital investment, which handicaps the operator in trying to get work for the rig since higher rates must be charged. A well balanced rig soon demonstrates its ability and attracts business to its owner. Sales organizations are always ready and willing to recommend suitably sized equipment.

Care and operation procedure is a subject which has not had the publicity it deserves. Neglected or abused equipment is liable to fail at a critical time and sometimes causes the loss of the hole. On the other hand, a program of periodical inspection and maintenance will keep equipment in shape to meet the emergencies that are encountered in drilling. Such a program is called "Preventive Maintenance." Its purpose is to discover and replace worn or badly damaged parts resulting from previous operations and to make sure that all parts are properly adjusted and tightened. Time and effort spent in carrying out this program will be repaid in reducing the amount of down time necessary to repair failures after they occur.

A program of preventive maintenance in regard to pumps may be said to begin with the use of correct liner sizes for the pressures encountered. Changes in liner sizes must be kept to a minimum but there is a natural tendency to put off changing to a smaller size as long as possible without stalling the engine. It is obvious that such practice overloads the pump, the prime mover, and the drive for a considerable part of the operating time. Pumps are designed to have a conservative life based on specific loading and have ample safety factor to carry considerable overload for short periods. Constant overload shortens the life of a pump by causing rapid wear and fatigue of working parts. Considering only the bearings used in a pump, a constant overload of only 10 per cent would reduce the expected life more than 25 per cent, and a constant overload of 25 per cent means a reduction of about 60 per cent in bearing life expectancy. To illustrate this graphically, Fig. 1 is a chart showing the effect of loading on bearing life and pump speed. If a minimum bearing life of 20,000 hours at 50 rpm pump speed is taken as 100 per cent loading, the chart shows that 109 per cent loading, or less than 10 per cent overload, decreases the bearing life to 15,000 hours or a loss of 25 per cent. A loading of 89 per cent, or 11 per cent less than full rating, increases the bearing life to 30,000 hours or a gain of 50 per cent. The chart also shows that, keeping the same minimum bearing life, the amount of permissible loading is greater as pump speed decreases and is less as pump speed increases. On this basis, overloads at low pump speeds are not as harmful as those at higher speeds. It is easy to understand from these figures that overloading a pump for long periods will require earlier and more frequent replacement of worn parts. Liner sizes should be changed as necessary to keep within the manufacturer's rating for the pump.

Pressure relief valves set to suit the liner pressure are intended to protect the pump against damage. In general, a satisfactory setting is about 50 per cent above the recommended pressure for the liner size being used. When liners are changed to smaller size, the set pressure is increased by using a larger nail. When the larger size liners are again installed, it is important to make sure that the nail size also is changed to suit. Never use a piece of welding rod in the relief valve. They were never designed to operate on that basis, and, in fact, it has practically the same effect as having no relief valve at all. Relief valves cannot give the protection expected of them unless used in accordance with the manufacturer's recommendations as stated on the name plate.

Pump liners, liner packing, pistons, piston rods, piston rod packing, valves and seats are expendable items. They have relatively short life because extrusion of the rubber parts and the abrasive action of the mud and sand cause rapid wear of these parts. Constant research is being conducted to improve these parts and increase their service life. It is false economy to try to use them beyond the time that they should be discarded.

Liners which have scored or pitted bores will tear up the fluid pistons in a very short time. Fluid pistons with damaged rubbers will allow mud to leak by and wash out the liners. New piston rubbers should be used with new liners—the old rubbers may damage the liner prematurely. Liners must have a generous chamfer at the head end to facilitate installing the fluid pistons without damaging the lips of the rubbers. Liners which are undersize on the outside diameter will be too loose in the fluid end, and the excessive clearance will allow the liner packing to extrude and fail. Many liner packing difficulties can be traced to too much clearance between the liner and fluid end adjacent to the liner packing space.

Liner packing usually fails because of extrusion of the bottom or inner ring into the clearance space between the liner and the fluid end. In addition to keeping the clearance space at a minimum, the bottom ring should be examined every time a liner is changed and replaced as often as needed. The outer packing ring probably will not need replacing as often as the inner one.

Keep the liner spacer set up tightly at all times. Loose liner spacers allow the liner to work and wallow out the fluid end. Working or end movement of the liner accelerates the extrusion of the liner packing.

Valves and seats will take considerable wear before being replaced, provided that the rubbers are kept in good condition to seal against leakage. The metal part of the valve forms the support for the rubber seal. Wear or

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†Presented at the tenth annual meeting of American Association of Oilwell Drilling Contractors at Tulsa, Oklahoma, October 9-10, 1950.

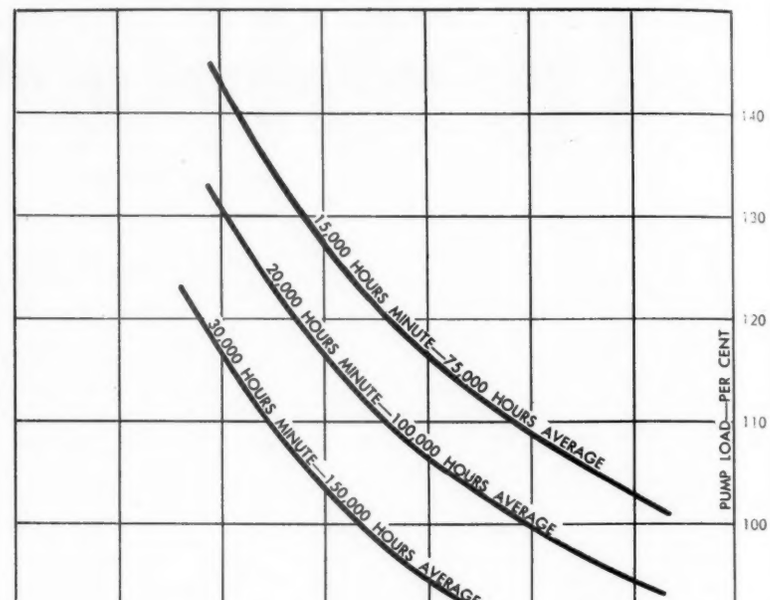
*Chief engineer, Wilson-Snyder manufacturing division of Oil Well Supply Company, Braddock, Pennsylvania.

small washes in the area where the metal part contacts the seat usually causes no harm until they reach the point where the effectiveness of the rubber seal is endangered. Worn or damaged rubbers should be replaced as soon as discovered. Valve seats which are washed or damaged in the rubber sealing area should be replaced immediately. Failure to make these replacements may result in a washed out valve deck. When replacing valves, make sure that the tapered surfaces of the bore in the pump chamber and the outside of the seat are clean and dry. Rust or sand particles will hold the seat away from the bore and allow the mud to wash out the valve deck. Valve seats depend on the taper and friction between mating parts to hold them in place. Oil or grease on the surfaces reduces the friction and allows them to slide when subject to the heavy loads encountered.

This same rule of clean dry surfaces applies also when a piston is installed on a piston rod. Many cases of loose fluid pistons have been caused by oily or greasy surfaces on the taper.

Worn, scored or pitted piston rods should be removed from the pump. It is impossible to pack off a scored or pitted rod, since the rod will tear up the packing with only a few strokes of the pump. Packing cannot be expected to do a really satisfactory job if the rod is worn undersize in diameter more than about 1/32-in. Much packing trouble is traceable to too much gland pressure on the packing, which then binds and scores the rod. If the rod surface is smooth and polished, moderate gland pressure should be sufficient to keep the packing from leaking. Flushing the rod with oil instead of water seems to preserve the polished surface and reduce the rate of wear. It is generally conceded that some form of self-sealing or V-type packing is best, but more information is needed as to how to use this packing most effectively.

Excessive fluid rod and diaphragm packing wear and rod fatigue can be caused by not keeping the rods centered in the stuffing boxes. Power end crossheads should be adjusted and fluid piston bodies replaced as needed to keep the rods centered. When a rod is off-center, it bears against the packing at one point, deforming the packing and causing excessive wear. At the opposite side of the rod, there will be a clearance between the packing and the rod, which allows air to enter the pump on the suction stroke and mud leakage to destroy the packing on the discharge stroke. Misalignment of rods, due to worn crosshead shoes and guides and worn piston bodies, imposes an extra strain at critical points, resulting in early fatigue failure. Rods must be kept tight in crossheads or extensions and lock nuts pulled up tight to prevent "working" and fatigue failures. Do not mar the surface of a rod by gripping it with a wrench in the packing rub area. Knurled or undercut wrench grips are provided.



Bearing life as related to pump load and pump speed.

FIG. 1

When crossheads are adjusted to center rods in stuffing boxes, sufficient running clearance must be provided to avoid binding. A clearance of about .010-in. on large pumps and .006-in. on small pumps is usually permissible for normal direction of rotation. Practically all pumps can be run in the reverse direction of rotation with no alteration except possibly to reduce the amount of running clearance between the crossheads and guides. Since the forces acting on crossheads during reverse rotation tend to lift them against the upper guides for most of the stroke length, excessive clearance will cause a knock at each end of the stroke when they drop back onto the lower guides. The suction and discharge piping of a circulating oil pump, either for power end lubrication or for fluid rod lubrication, will have to be reversed when a slush pump is run in reverse rotation.

The mud baffle and diaphragm packing are designed to keep mud out of the power end and should be kept in good condition. The mud baffle deflects fluid rod stuffing box leakage and prevents it from reaching the diaphragm packing, but if the leak is really bad, the mud spray will fill the cradle section, find its way past the baffle, destroy the diaphragm packing, and enter the power end to contaminate the oil.

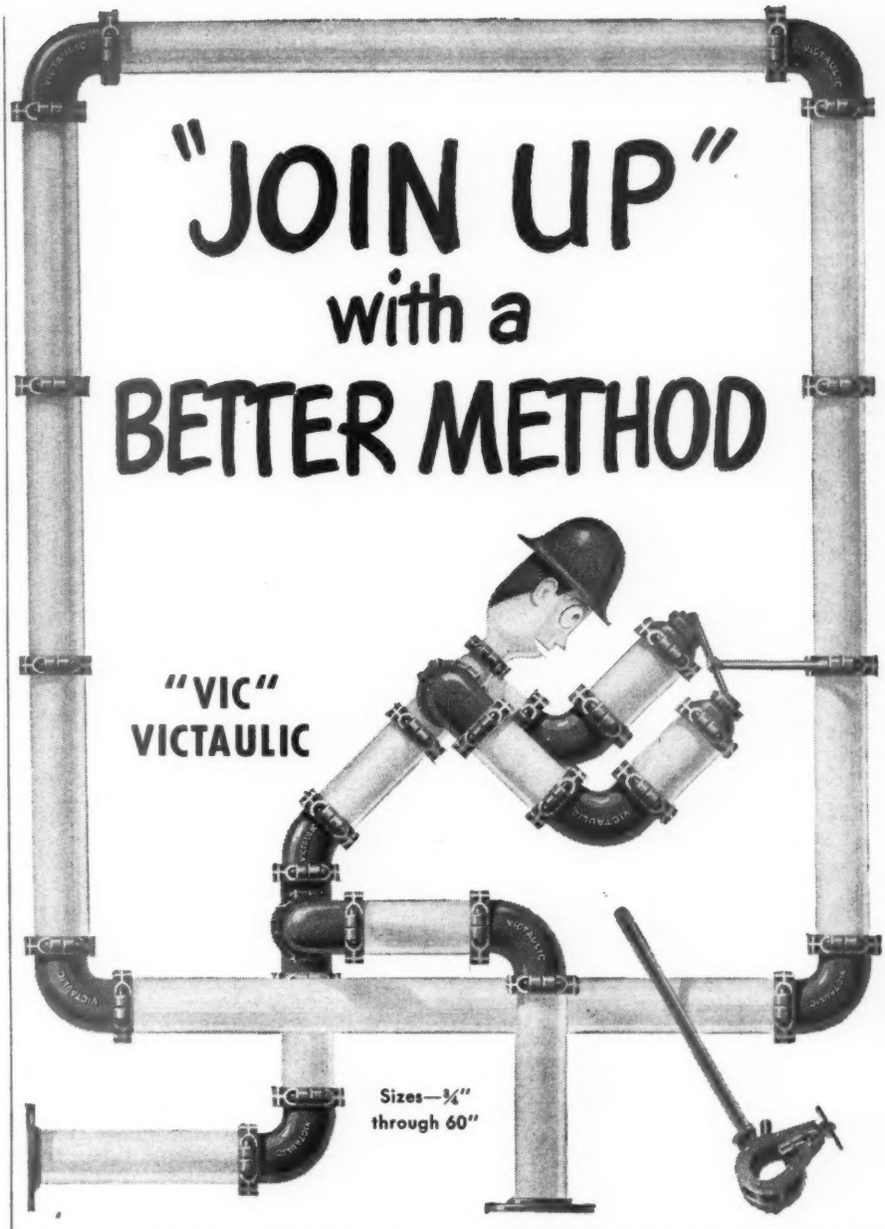
Dirty, contaminated lubricating oil is probably the cause of a major part of power end troubles. The mixture of oil and mud is a good lapping compound and quickly wears the working surface of bearings, gear teeth, and crosshead slides, causing them to be loose. Water in the oil will etch bearing surfaces and gear tooth faces, reducing their usefulness. The cheapest and best insurance agents excessive power end trouble is the use of good, clean oil of the proper type. The pump manufacturer recommends lubricants, and these recommendations should be followed. There are, however, only

three main requirements the oil has to meet: First, it must be clean; second, it must be non-corrosive; and third, it must have sufficient film strength to carry the gear tooth load. The effectiveness of lubricating oil varies with the changes in the surrounding temperature. It gets less viscous, or thin, when heated and more viscous, or heavy and sluggish, when cold. Use a relatively heavy viscous oil during the hot summer months and a lighter, less viscous oil during the colder season. For sub-zero temperatures, consult the pump manufacturer.

The importance of clean lubrication cannot be over-emphasized. An analysis of samples of oil taken from many pumps now in operation will show surprising results as to the amount of water and grit they contain. Contamination can be kept at a minimum by seeing to it that the fluid rod packing and diaphragm packing are kept in good condition and by changing oil in the power end at three or four month intervals or oftener as needed. If a large amount of mud does enter the power end, drain the oil as quickly as possible, flush out the power end and parts thoroughly, wipe inner surfaces with rags where indicated and fill with clean oil. Find the cause for the mud getting into the power end and remedy it before starting the pump.

The bearings of the power end should be kept adjusted as recommended by the pump manufacturer. In the presence of good clean oil, bearings will run for long periods before adjustment is needed. Bearings quickly develop looseness and require frequent adjustment when subject to the lapping action of an oil and mud mixture. It is an established fact that bearings cannot be expected to perform satisfactorily if they run in dirty oil. Where bearings are worn and cannot be adjusted, it is necessary to replace the worn bearing with a new one. When replacements are necessary, replace the entire bearing and not just part of it, as for example, a cone or a cup. It is impossible to obtain good performance and life from a bearing if a new part is used with old parts. Replacement can be much more expensive than changing the oil to keep it clean.

There should be no looseness in the crank pin bearings or the main bearings. The load on these bearings changes direction with each reversal of stroke, and any looseness will result in a severe shock when the clearance is taken up. The stresses due to impact or shock loading are incalculable, but it is a matter of record that many broken shafts, cranks, connecting rods and bolts can be traced to



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loose bearings. Under impact loading, the stress at some point in a shaft or crank may be above the endurance limit of the material, and a crank will develop which, in all probability, will cause the part to fail. Even though the peak stress may be in only a very small region of the part, the crack may form and, once formed, will spread under the influence of only moderate loads and ultimately lead to failure of the part. This accounts for the fact that many failures seem to occur under normal loads, whereas the truth is that the crack formed at some remote previous time under a severe overload and has taken all of the intervening time to spread and cause failure. Periodical inspection can detect the presence of fatigue crack before final rupture occurs.

All bolting throughout the pump should be kept tight. Here again, looseness will cause impact loading. Bolting should be checked for tightness after the first two to four weeks of operation, and thereafter at regular inspection periods. Bolting for valve covers and fluid cylinder heads, which have gaskets, should not be tightened in sequence around the circle but should be drawn up evenly by tightening a bolt on one side then one on the diametrally opposite side until all bolts are tightened. This procedure distributes the load uniformly around the gasket to provide a more effective seal. Gaskets should be handled carefully to avoid damage when installing and removing covers. A damaged gasket will not seal properly and should be replaced immediately.

The pump should be set on level, solid ground. Uneven ground under the skids will warp the pump and cause strains. Pump skids should be adequate in size for the weight of the pump and long enough to prevent damage to the pump while loading onto and unloading from trucks when moving the rig.

The suction line should be short and direct and not smaller than the size of the pump suction connection. Long radius bends should be used in order to obtain best flow chara teristics. Suction lift should be kept as low as possible. Where long suction lines and/or high suction lift is unavoidable, the use of a suction air chamber usually prevents fluid end knocks due to water hammer. Air pockets and air leaks must be kept out of the suction line. Where air pockets are present, air may be drawn from them in sufficient volume to break the column of fluid in the suction line and cause the pump to lose its prime. Air leaks in the suction line can also cause the pump to lose suction, and in any event, they will lower the efficiency of the pump by reducing the amount of mud that is drawn in and discharged during each stroke.

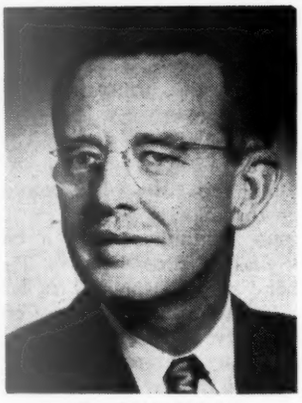
The use of a suction strainer will keep debris out of the pump. Large objects, entering the pump, can lodge under the valves and may cause a washout. A strainer will not function properly unless cleaned frequently to remove the trash which may obstruct the flow. Sand that settles out of the mud can also block the suction passages. Most fluid knocks are caused by the pump not filling completely during the suction stroke. Examine suction line and strainer for leaks or obstructions. Also check the valve cover and fluid cylinder head gaskets for air leaks. A strainer in the discharge line is a good safety precaution since it will catch any small pieces of rubber from valve discs or other small trash which may get into the pump. This is particularly important for jet bit drilling where such objects may clog the small water courses.

When a pump is idle, especially in a humid atmosphere, rust and corrosion will attack exposed finished surfaces. Idle pumps, especially standby pumps, should be protected by coating exposed rods and other surfaces with a light grease. Wipe the rods clean to remove any windblown grit before starting up. When rig is stacked, the pumps should be protected by weather-proofing all exposed finished surfaces, including rods, shaft extensions, and the grooves of the V-belt sheaves. Oil should be drained from the power end so as to remove along with it any grit or water which may have accumulated. Fill the pump with the required amount of fresh, clean oil when it is put in service again. Drain the fluid end at all times when the pump is likely to be standing idle in freezing weather. It is easier to prime a pump than to repair broken castings.

Spare parts are kept on hand so as to be able to make replacements quickly when necessary and so avoid keeping the pump shut down until a part can be obtained from the supply store. They are, however, of little use and a waste of money if they are allowed to get damaged through careless handling and storage. A protected place should be provided in the tool shed where they can be stored so that heavy tools and other parts cannot be dropped on them.

All of this sounds like an ambitious program and a lot of work. However, all of it is being done now as a matter of necessity to repair failures as they occur. It is better to institute a program of periodical inspection and preventive maintenance to detect weak-

Receive Distinguished Service Awards



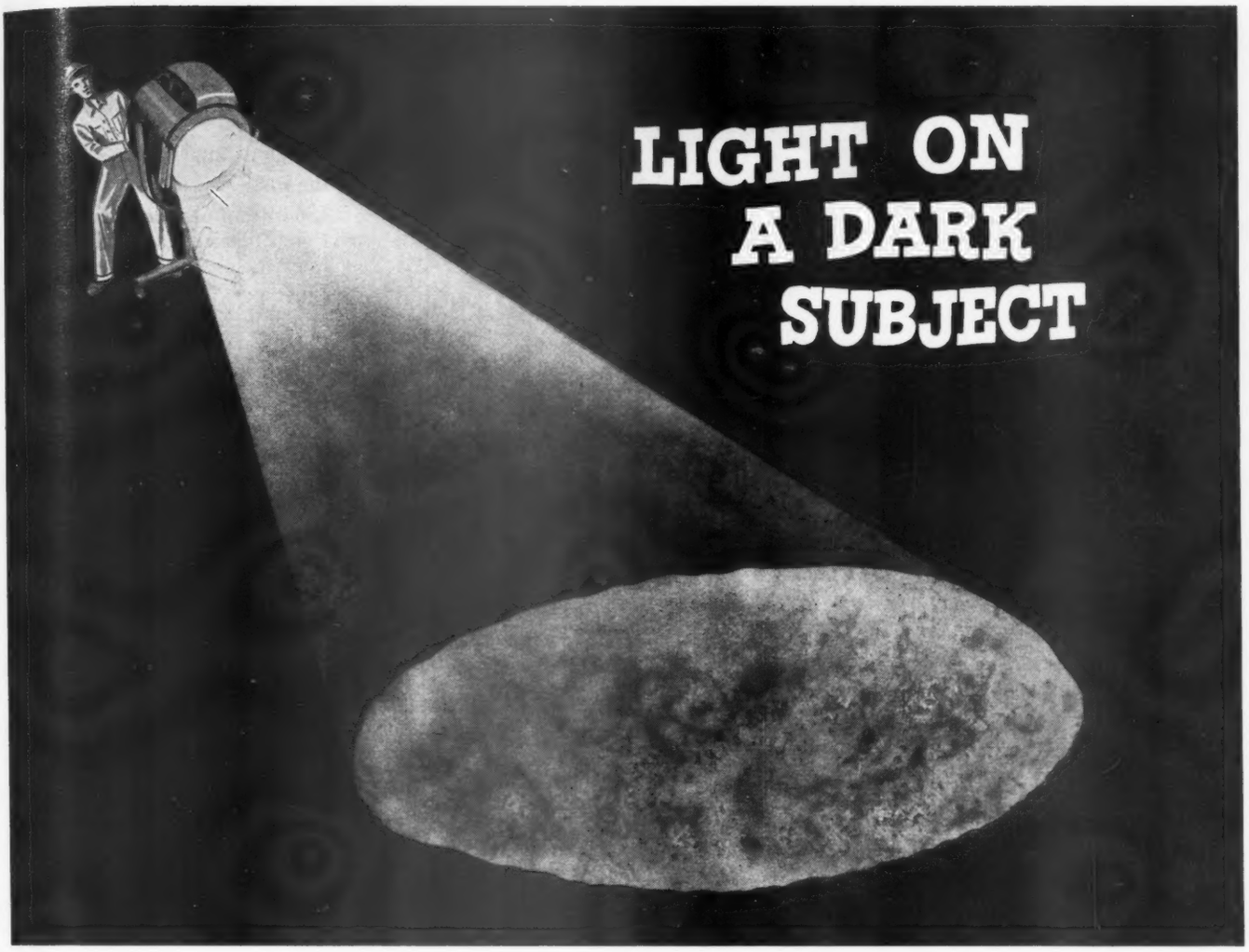
Fred W. Shield

J. S. Leach

At its 31st annual meeting in Dallas, Texas the Texas Mid-Continent Oil and Gas Association gave its Distinguished Service Awards to Fred W. Shield, San Antonio oil operator, and J. Sayles Leach of Houston, who was named executive vice president of The Texas Company, New York, in August of this year. In recognition of their service to the petroleum industry, the awards were presented to Shield by Russell McFarland, Dallas, vice president, Seaboard Oil Company of Delaware; and to Leach by R. B. Anderson of Vernon, president of the Association.

In years of trading, swapping, and misfortune, Shield participated in drilling 55 dry holes before he got a producer. He opened the Loma Alto field in 1934.

Leach began work as a bookkeeper for The Texas Company in 1916 after graduation from Baylor University, Waco. He became a vice president of the company in 1938, a director in 1949.



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nesses before failure occurs. Such a program could easily cover:

1. Liner sizes to keep within the manufacturer's rating for the pump.
2. Suitable relief valve, set to suit the liner size used.
3. Liners and pistons in good condition. Full size outside diameter of liner to suit the fluid chamber.
4. Liner packing in good condition and liner spacer set screws kept tight.
5. Valves and seats properly installed and flexible sealing discs in good condition.
6. Piston rods smooth, not worn excessively, and centered in the stuffing boxes.
7. Piston rod packing properly installed and adjusted.
8. Diaphragm packing in good condition and extension rods centered in the packing space.
9. Power end crossheads properly adjusted and fluid piston bodies in good condition to keep the rods centered in the stuffing boxes.
10. Good, clean oil in the power end. Change oil frequently to remove contamination.
11. Bearings adjusted as recommended by the pump manufacturer. Replace worn bearings which cannot be adjusted. Replace the complete bearing and not just part of it.
12. Check all bolting for tightness at regular intervals and in any event after the first two to four weeks of operation.
13. Keep suction line short and direct with long radius bends. Keep suction lift as low as possible. Avoid air leaks and air pockets in suction line.
14. Use a suction strainer and clean it frequently. Do not let sand accumulate in the suction line or passages of the pump.
15. Use a strainer in the discharge line to catch small objects which get past the suction strainer or break off from the valve discs or piston rubbers.
16. Use a full size discharge line from the pump to the standpipe.
17. Protect idle pumps from damage by coating exposed finished surfaces with light grease. Wipe off before starting up.
18. Protect stacked pumps by weather-proofing exposed parts.
19. Drain fluid ends when pumps are to stand idle in freezing weather.
20. Protect spare parts by providing safe storage space. * * *

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UPPER ZONE TESTING — COMPLETIONS . . . NITRO TAMPING . . . FALSE BOTTOMS . . . MULTIPLE ZONE TESTING — SQUEEZE JOBS.
because
They give positive, leak-proof packoff under differential pressures to 10,000 psi.
THEY'RE QUICK AND EASY TO RUN AND SET. No pumps needed — no waiting for cement to set — Run on conductor cable — or (with special setting tool) on wire line or tubing.
THEY'LL OUTLAST CASING ON PERMANENT INSTALLATION.
YOU CAN DRILL THEM OUT IN 4 TO 6 HOURS WITH EITHER ROTARY OR CABLE TOOLS.
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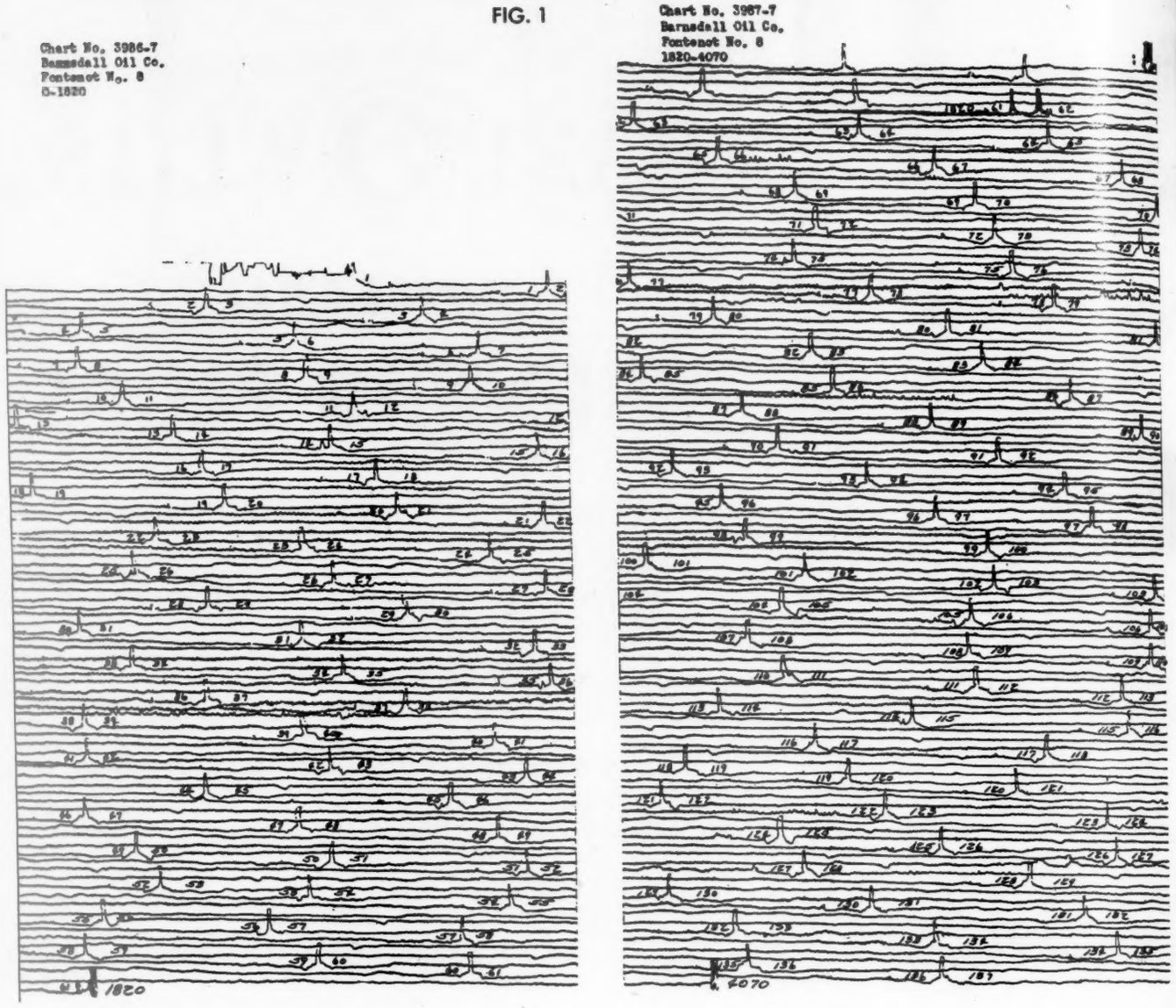
FIG. 1



P 531.

Inhibitor in Stick Form Stops Corrosion in Louisiana Gas Well

G. M. HARPER, JR.*

VISUAL inspection of the surface equipment of the A. O. Fontenot So. No. 8 gas distillate well in the Iowa field, Jefferson Davis Parish, Louisiana, clearly indicated that the well effluent was definitely corrosive. The well was originally completed as a gas distillate well on December 30, 1945. Completion data was as follows:

(a) 10¾ in.—40.5 lb surface casing was set at 1523 ft.
(b) 6⅝ in.—26 and 28 lb oil string was set at 8805 ft.
(c) 2⅞ in.—6.5 lb, N80 tubing was set with a Lane-Wells Olympic BOC 30 packer at 8531 ft.
(d) Production perforations were from 8704-8754 ft Schlumberger measurement.

The state potential test was made June 13, 1946 with these results:

Choke: 16/64 in.
Tubing pressure: 3335 psi
Distillate rate: 118.56 bbl/day
Gas rate: 4659 MCF/D
Gas-oil ratio: 39,000 cf/bbl
Corrected gravity: 54.1 API

Inspection in May 1948, revealed

*Production engineer, Sunray Oil Corporation.

EXCLUSIVE

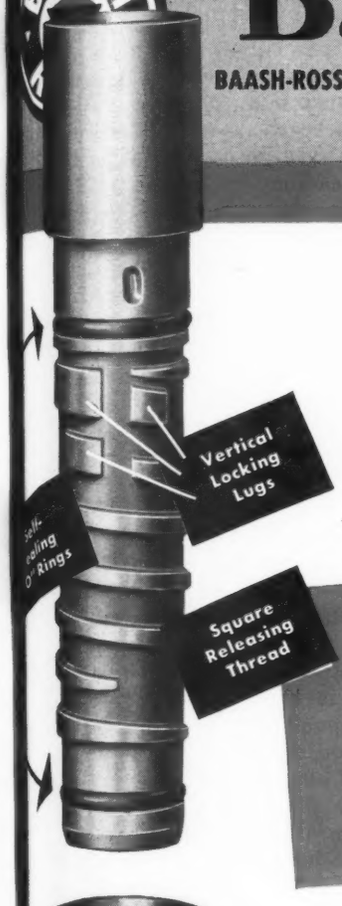
Baash-Ross News

BAASH-ROSS TOOL COMPANY • LOS ANGELES • HOUSTON • OKLAHOMA CITY • NEW YORK

OUR 30th YEAR

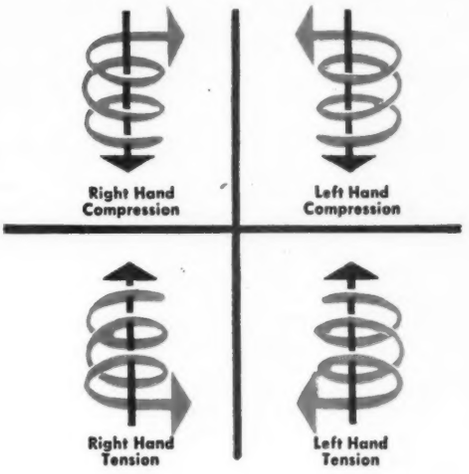
ANOTHER NEW BAASH-ROSS PRODUCT!

A simple, positive way to REMOVE STUCK TUBING STRINGS FROM YOUR PRODUCING WELLS



BAASH-ROSS PRODUCTION SAFETY JOINTS

4 TYPES TO MEET EVERY PRODUCTION REQUIREMENT



Why run the risk of costly salvage operations every time stuck packers, sanding conditions or similar difficulties jeopardize recovery of your tubing string, when it costs so little to insure recovery by using Baash-Ross Production Safety Joints?

A Baash-Ross Production Safety Joint placed in your tubing string provides a positive means of freeing the string at the point where the Safety Joint is installed, thus permitting important savings to be made in production operations. For example . . .

▶ Where production packers are used, a Safety Joint should be installed above the packer to permit positive and complete release of the tubing string should the packer become stuck.

▶ Where sanding conditions exist, one or more Baash-Ross Production Safety Joints should be installed in the tubing string to permit selective release and maximum recovery.

▶ Where it may be desirable to change production methods in a well, a Baash-Ross Production Safety Joint should be installed in the tubing string to permit such changes to be made quickly and easily without disturbing the packer.

Baash-Ross Production Safety Joints are simple in design, positive in operation and low in cost. They are provided with a unique locking lug that permits heavy rotational loads to be transmitted through the Joint without loosening it—yet disengagement can be quickly made whenever desired by merely following a simple sequence of operations. A choice of *four* different releasing actions is available—either *left* or *right* hand rotation, combined with either *raising* or *lowering* the production string—thus providing the exact releasing action best suited to each production hook-up.

LEAK-PROOF SEAL . . . FULL OPENING PASSAGE

Note in the illustration how the Baash-Ross Production Safety Joint is packed off top and bottom with self-sealing "O" rings to permit circulation through the Joint without leakage. Also, the Joint is full-opening so that rods, tools and clean-out equipment can be passed without difficulty. In fact, the Joint has the same internal and external diameters as the production string itself. Anything that will pass through the tubing string will pass through the Joint . . . and the Joint itself will pass through anything the tubing couplings will pass through—an important consideration when used with certain types of suspensions.

A Size For Every Production Need

Baash-Ross Production Safety Joints are made of heat-treated alloy steel and are available in all four releasing actions to fit all sizes and types of API Tubing. So no matter what the nature of your particular production operations, you can protect against costly recovery or conversion operations by placing one of these efficient Joints on every tubing string.

QUICK POSITIVE RELEASE

Here's how the Baash-Ross Production Safety Joint operates to protect your tubing strings. The Joint consists essentially of a box and pin releasing thread (either right or left hand, as ordered) that is packed off top and bottom with self-sealing "O" rings. In the upper portion of the pin thread, two vertical lugs are machined into the body, and these lugs mate with a corresponding lug machined into the box portion.

The releasing threads are cut with a loose fit—that is, when the Joint is made up, the two portions can move a short distance longitudinally with respect to one another without affecting the vertical alignment of the Joint. This movement permits the mating lugs to lock and unlock as one portion of the Joint is moved with respect to the other portion—and the design of the lugs determines whether the Joint unlocks in tension or in compression. A shear pin is also provided that permits longitudinal movement of the Joint, but prevents premature rotational release.

Basically, the releasing action consists of first unlocking the lugs by lowering (or raising) the string—then rotating the string in the proper releasing direction (either right or left) to sever the shear pin and unscrew the Joint. Only by first moving the string in the proper vertical direction, then rotating it in the correct releasing direction, can the Joint be disengaged—and by properly selecting the releasing action, other tools below can be set and released without risk of disengaging the Joint.

that the choke and the choke tee adapter were severely corroded, necessitating their replacement. Inspection of the choke body revealed that it was heavily corroded on the upstream side of the choke extending along the bottom of the body bore to the ring groove and ring. The downstream bore, ring groove, and ring were lightly corroded. The wing valve was also removed and found to be heavily corroded on the downstream side along the bottom of the bore extending out to the ring groove and ring. Corrosion was light on the upstream bore and ring groove. A rubber ring guard was used in conjunction with the upstream ring.

Because of the conditions prevalent in the wing valve and component parts, the Christmas tree was dismantled completely for inspection. This was accomplished by placing Otis Pressure Control regulators in the tubing at 1000 and 2000 ft and a plug at 500 ft. Both master valves were found to be lightly corroded. The bottom master valve was replaced with a stainless steel master valve with a body of 12 per cent chrome and 0.5 per cent nickel. All other damaged parts were repaired or replaced. Some corrosion had occurred in the flange pad threads below the master valve. It was not considered serious enough to be dangerous as a tubing support.

The corrosion damage evident in the Christmas tree made a survey of probable tubing damage advisable. To do this, an Otis Pressure Control tubing caliper survey was made on June 30, 1948. The results of this survey indicated that tubing corrosion was in its early stages in several joints, but was not serious. The instrument readings for the top 4070 ft of tubing are shown in Fig. 1. See Fig. 2 for interpretation of chart readings.

The well was placed back on normal production and testing was begun to determine the degree of corrosiveness of the well effluent. With the cooperation of the Tretolite Company, test coupons of material similar to J-55 tubing were inserted upstream of the well choke for two week periods.

Pairs of these test coupons were bolted to the flattened end of a ½-in. steel rod. The other end of this rod was threaded and screwed into the inside surface of the plug. This plug was then attached to the choke tee so that the coupons extended into the flow line upstream from the choke, as illustrated in Fig. 3.

The coupons were weighed to the nearest thousandth of a gram both before and after the test period. The weight loss was then converted into "mils penetration per year" of the tubing. Hereinafter this figure will be referred to as the "M.P.Y. factor."

The first two sets of test coupons installed for two two-week periods showed a weight loss of 2.089 and 1.911 grams, respectively, or approximately 6.0 per cent. Converting these weight losses to the M.P.Y. factor they would be 50.7 and 51.1, respectively. Factors of this magnitude indicated that a severely corrosive condition existed.

In addition to test coupons, weekly samples were taken of the water condensate, and these samples were sent to both Tretolite and Benton Unit laboratories for iron content analysis. A simplified method that could be used in the field for determining the iron content was made available later, and is outlined at the conclusion of this article. To substantiate the findings of test coupons, the iron analysis of nine water samples showed an iron content of 200 to 250 ppm. An iron content of over 25 ppm was considered enough to require treatment.

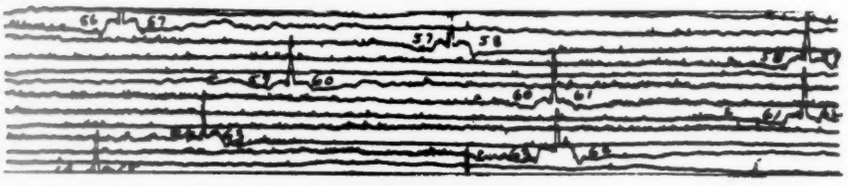
As severely corrosive conditions were indicated by the coupons and also by water analyses, it was necessary to select a method of treatment immediately. Due to the fact that the well was completed with a packer with mud in the annulus, treatment was limited to the injection of the chemical into the tubing. This could be accomplished either by running a macaroni string of tubing inside the

CHARACTERISTIC RECORDINGS OF TUBING CORROSION

Below are portions of Caliper charts taken from Tubing Corrosion Surveys of other wells. These typical recordings of non-corroded and corroded tubing may be generally compared against charts included in the Report on Tubing Corrosion Survey of your well.

1. NO CORROSION

Lines on chart indicate no corrosion in this string of tubing. When scaled out, the .03 to .04 in. deflections on either side of each coupling appear to represent mill deviations from normal internal diameter, rather than corrosion pits.

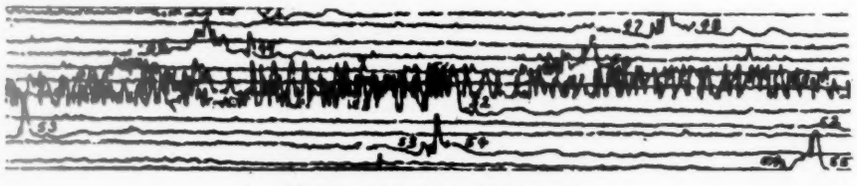


2. CORROSION

Numerous erratic deviations (as compared to relatively smooth chart lines shown on No. 1) indicate shallow pits of corrosion in its early stages.

3. SEVERE CORROSION

Very pronounced deflections on either side of the couplings indicate severe corrosion, especially in the lower upset of each joint. Reduction in tubing wall thickness in the lower upset of Joint No. 81 is over 35 per cent.



4. SEVERE GENERAL CORROSION

Mass of continuous irregular lines indicates that this string of tubing is corroded beyond the margin of safety, and that complete penetration has probably already occurred between, and in, the upsets.

TEAMWORK GETS RESULTS!

The SUPER-SERVICE LINER with "Satin Finish" *completes* the Mission Slush Pump Team

Mission Silver Top Valve for Normal Pressures

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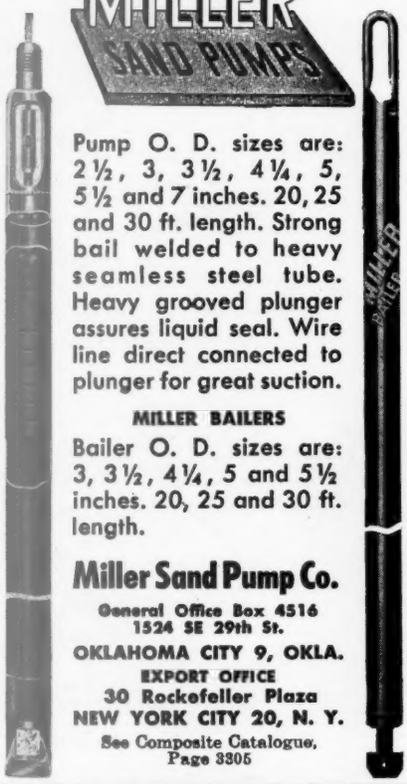

Pump O. D. sizes are: 2½, 3, 3½, 4¼, 5, 5½ and 7 inches. 20, 25 and 30 ft. length. Strong bail welded to heavy seamless steel tube. Heavy grooved plunger assures liquid seal. Wire line direct connected to plunger for great suction.

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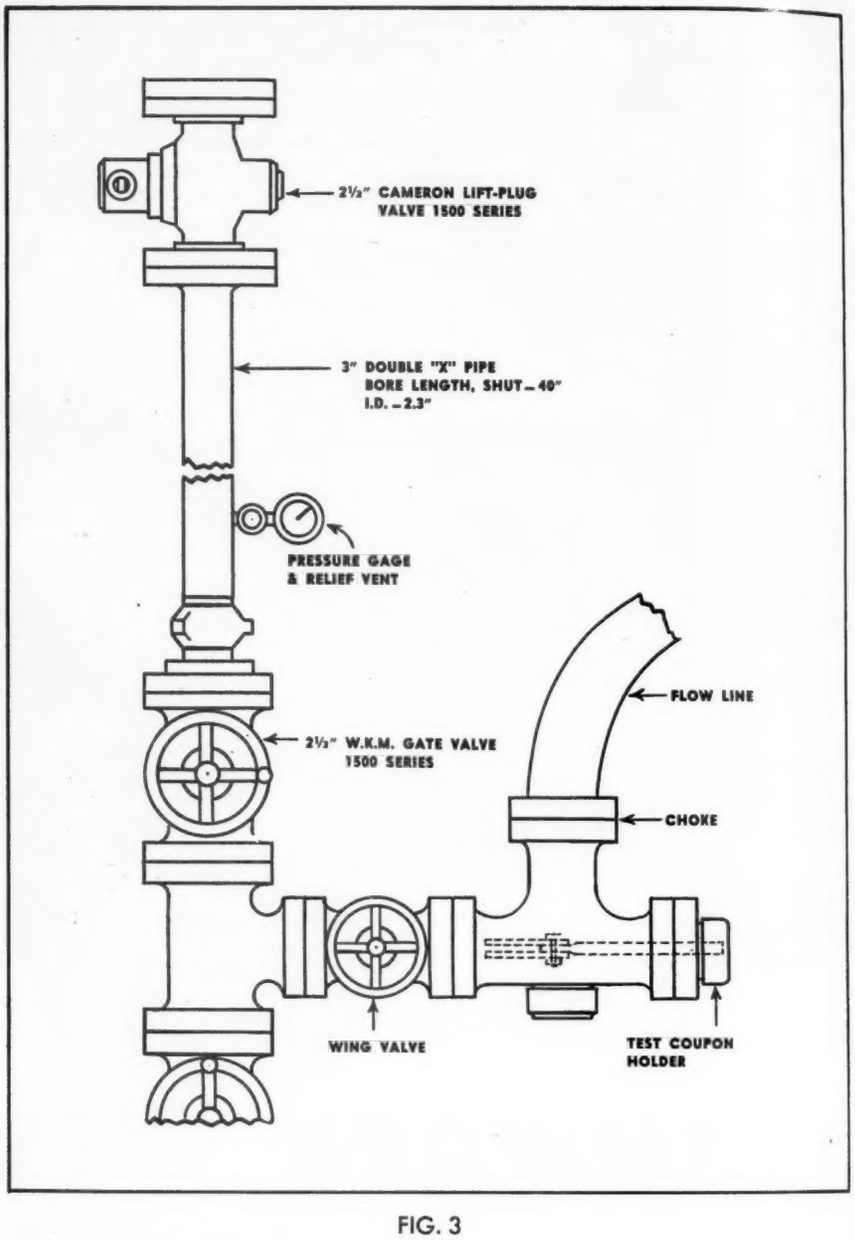

2½" CAMERON LIFT-PLUG VALVE 1500 SERIES
3" DOUBLE "X" PIPE BORE LENGTH, SHUT—40" I.D. —2.3"
PRESSURE GAGE & RELIEF VENT
FLOW LINE
2½" W.K.M. GATE VALVE 1500 SERIES
CHOKE
WING VALVE
TEST COUPON HOLDER

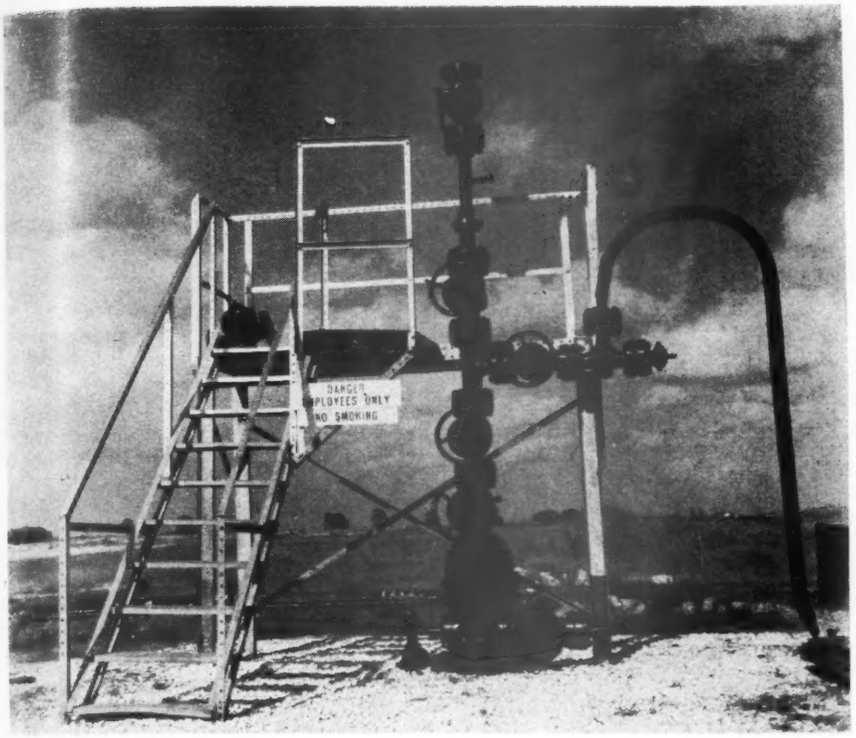
FIG. 3

2⅞-in. tubing or by shutting the well in for a short period and dropping the chemical in stick form, permitting it to be dispersed from the bottom while the well produced. We chose the latter method for its simplicity and economy.

At this time there was only one chemical on the market designed for this particular purpose, Tretolite Company's Kontol 115 Stick. Kontol is described as an organic product, which adsorbs at the metal surfaces forming an impervious film that protects the tubing from the corrosive well elements.

Treatment of the well with Kontol 115 Stick was begun on August 2, 1948, at the rate of 4 sticks per day, which amounted to 1¼ sticks per 1,000,000 cu ft of gas produced. Testing was again resumed employing both test coupons and water analysis as used previous to treatment. Results of tests with Kontol 115 Stick were not satisfactory, as indicated by the graph of results, Fig. 4. Coupon weight losses remained about the same as before treatment, averaging 2.075 gms. The iron content of the water condensate was erratic, averaging 120 ppm compared to 200 ppm before treatment, and still not approaching the desired maximum figure of 25 ppm. The test was discontinued until a more suitable chemical could be found.

Shortly after discontinuing the application of Kontol 115 Stick, the Tretolite Company recommended Kontol 118 in stick form, designated as Kontol 201. Using Kontol 201, treatment was resumed on December 18, 1948, at the rate of 2/3 stick per



Sunray Oil Corporation's A. O. Fontenot So. No. 8 gas distillate well in the Iowa Field, Jefferson Davis Parish, Louisiana.

MMCF gas produced. Testing was again resumed using the same procedures as previously. Better results were apparent immediately. (See Fig. 4.)

Coupon weight loss for three two-week periods dropped to an average of 0.018 gms compared to 2.027 gms previous to treatment and 2.075 gms with Kontol 115 Stick. The M.P.Y. factor now averaged a low figure. Iron contents of the condensate water were down to 7 ppm average compared to 200 ppm before treatment, and 120 ppm with Kontol 115 Stick. This was less than the 25 ppm considered to be maximum for satisfactory protection.

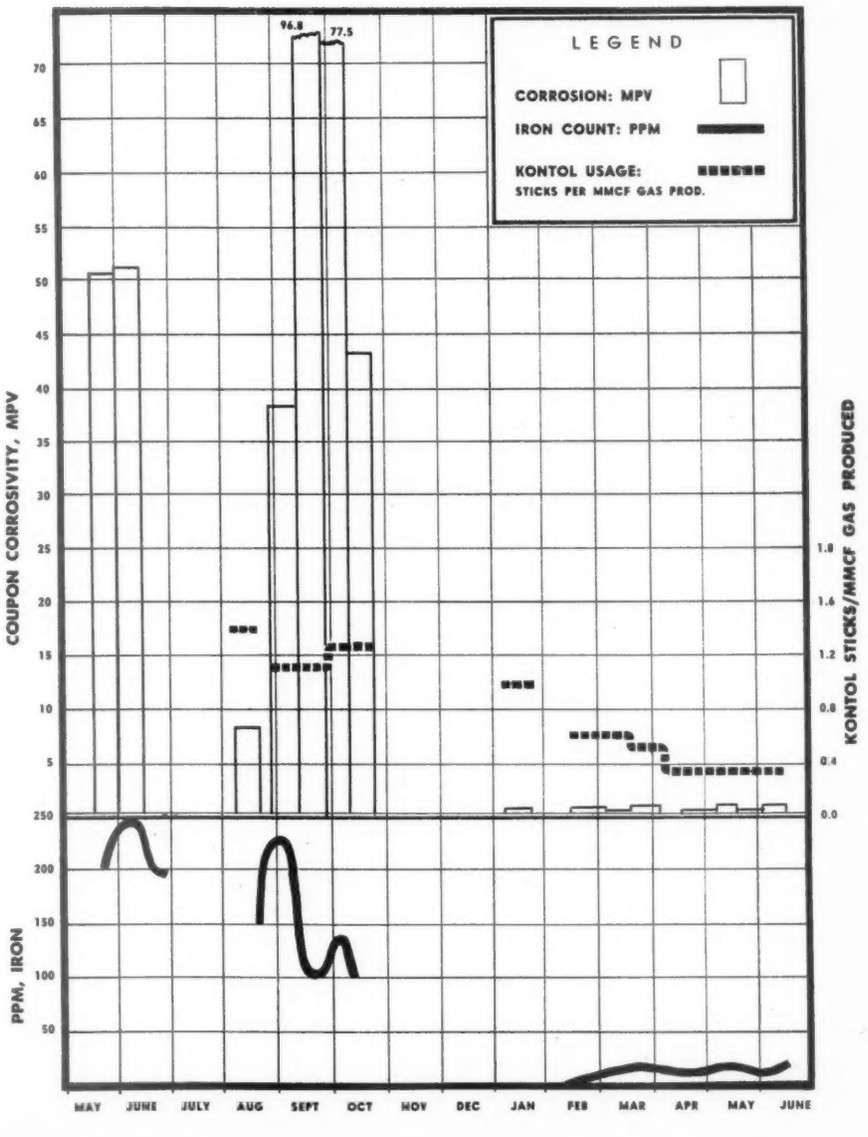
As excellent results were obtained using Kontol 201, experiments were begun to determine the most economical injection rate and still maintain adequate protection. Treatment was reduced on 3-29-49 to 1/3 stick per 1,000,000 cu ft of gas produced. Two months of testing at this rate revealed the following: Coupon weight losses remained about same as with the previous rate averaging 0.022 gms, while the iron content of the condensate water increased to an average of 20 ppm. As this figure was approaching the maximum of 25 ppm, further cuts were not considered advisable. Exposure of test coupons was then discontinued, but a monthly check has been maintained on this well by water analysis.

During the last 14 months the iron contents have not been over 25 ppm. On May 24, 1950, a second caliper survey was run on the well. The chart of this run, Fig. 5, when compared with the chart for the survey made 2 years previously, indicates little additional corrosion had occurred. This was, in fact, mentioned in the report submitted by the Otis Pressure Contol, Inc., which stated "The Caliper Survey Charts indicates the 2½ EUE tubing string in this well to be in approximately the same condition as the previous survey."

From experience gained on this well, it is apparent that corrosion in gas distillate wells can be successfully inhibited by means of organic chemicals in stick form.

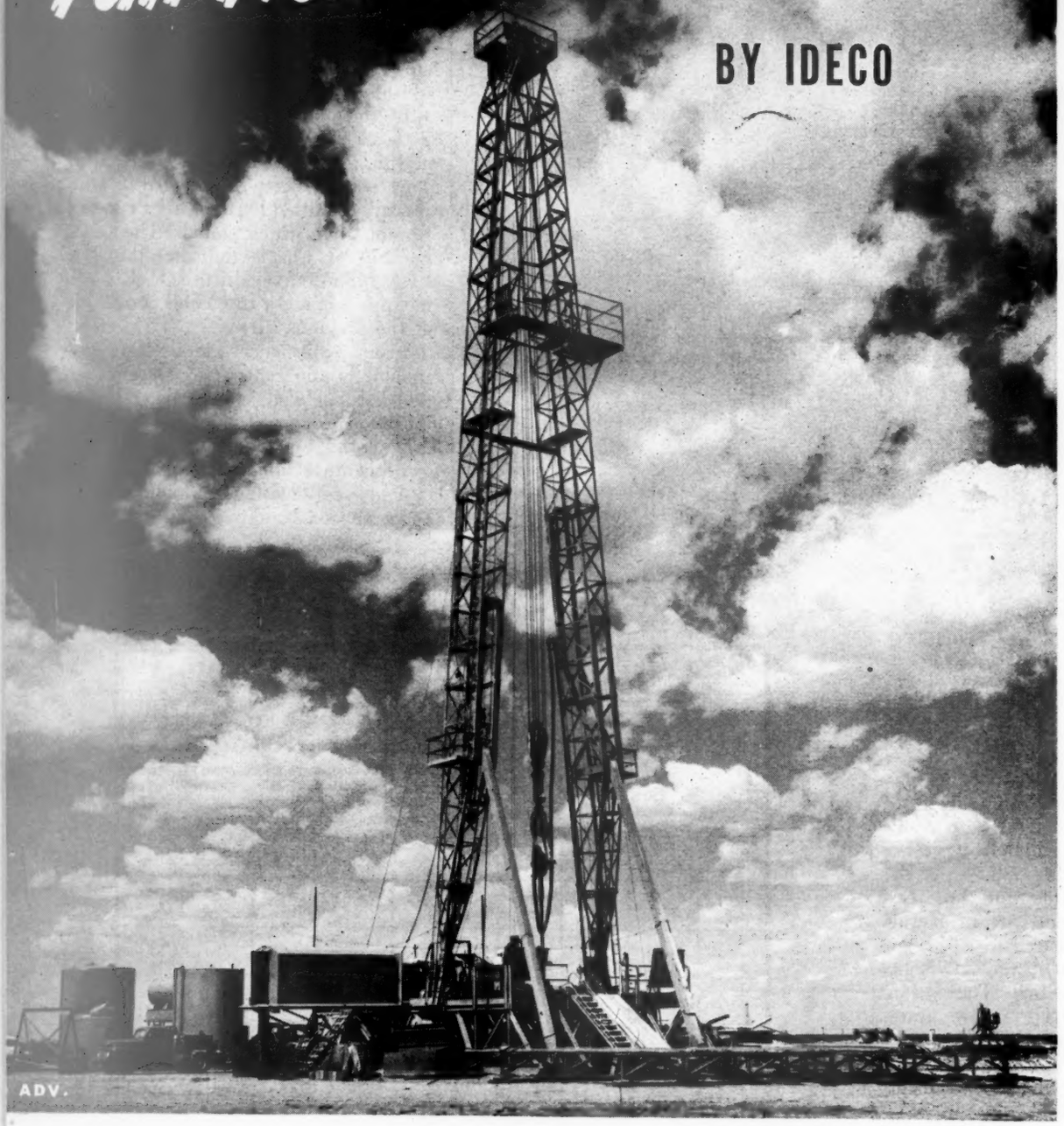
From an economic standpoint the cost of such treating is small. Kontol costs approximately $0.75 per stick

FIG. 4



Full View Mast

BY IDECO



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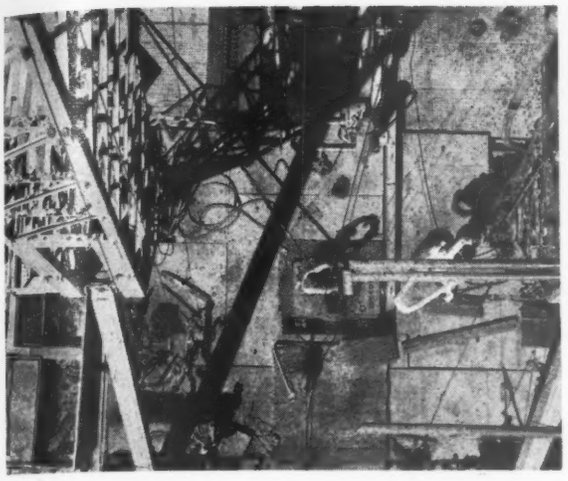
The widespread legs permit the use of any type or size drilling rig and provide plenty of clear space around the catheads. The large drilling floor measures 24′ from drawworks to pipe ramp and 27′8″ from side to side.

Raised by means of the traveling block, the *Full-View Mast* is virtually pushed upward to drilling position by a pair of raising legs, pivoted at ground level. Automatic safety locks are engaged by the raising legs as the mast approaches vertical, holding it in an upright position. It is positively secured by setting manual lock jacks. Easily and quickly raised, the *Full-View Mast* has the additional safety factor of not going over center when erected.

The *Full-View Mast* obtains its unusual stability from the widespread placement of the four legs and the latticed-box construction of the two main mast legs.

The mast has been designed for ease of movement. For field moves, the entire rig, with mast erect, may be skidded between locations; or the mast may be lowered to horizontal, removed from the base and transported in one, two or four loads.

More detailed information is available upon request. Write to Department 215, International Derrick and Equipment Company, Dallas 1, Texas.



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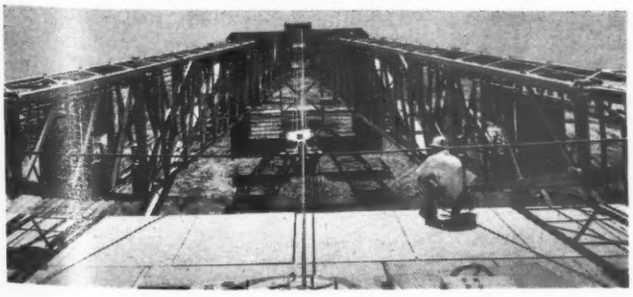
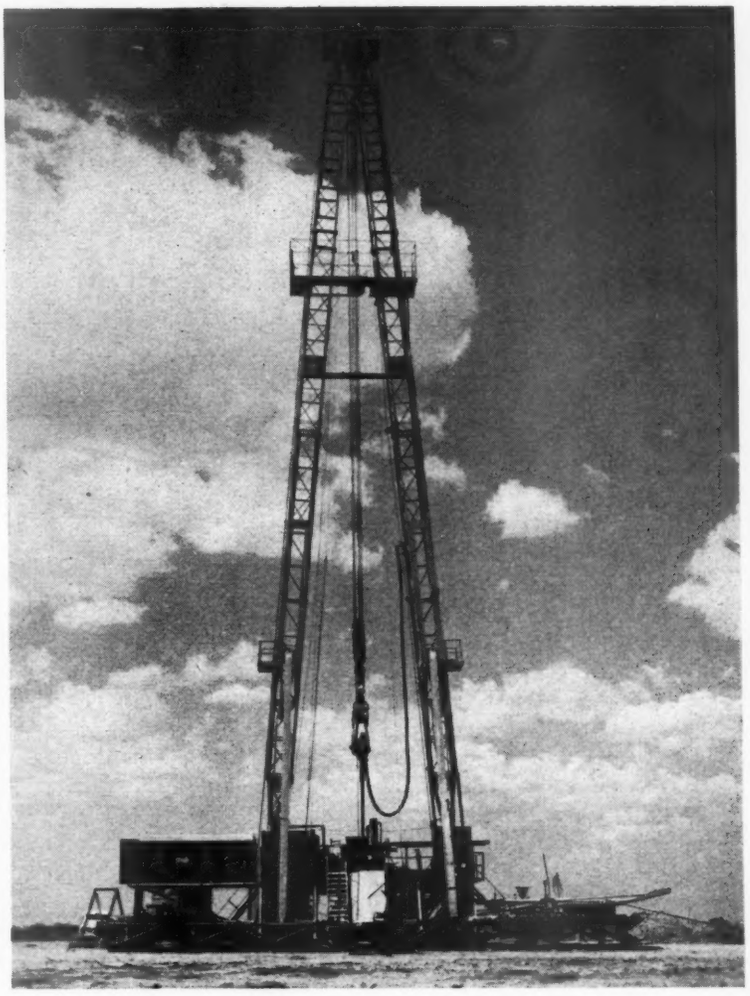
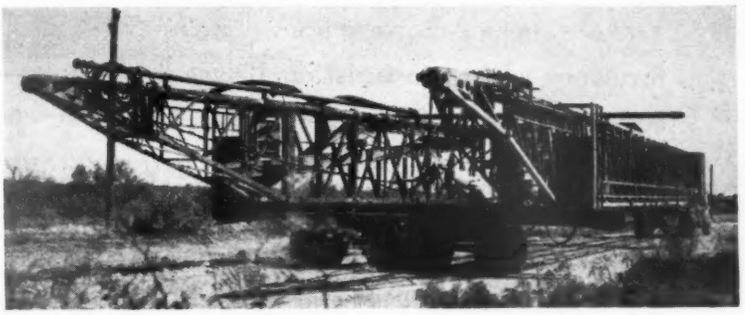


DURING THE ENTIRE RAISING OR LOWERING OPERATION THE DRILLER HAS PERFECT VISIBILITY AND CONTROL.



FULL VIEW DESIGN GIVES EXCEPTIONAL RIGIDITY AND VISIBILITY.



WHEN MOVING, THE MAST CAN BE TRANSPORTED WITH THE LEGS OPEN AS SHOWN OR THEY MAY BE DRAWN TOGETHER TO FORM A 7'6" WIDTH LOAD.

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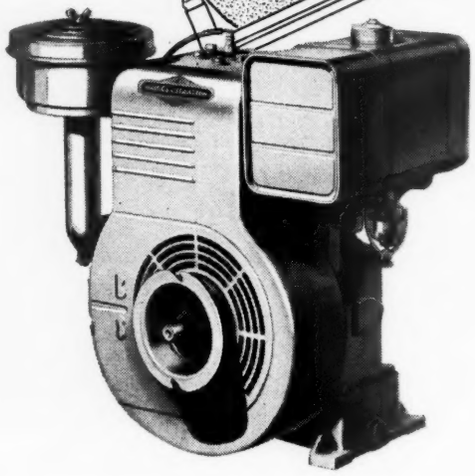

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which, at the present production rate, amounts to $0.25 per 1,000,000 cu ft of gas produced to be added to the lifting cost. This cost, compared to replacing the tubing or surface equipment, coupled with the loss of production as a result of shut downs, possible fishing jobs, and even blow-outs or the loss of the well, is negligible.

The results of the testing described herein suggest that all gas distillate wells should be checked periodically for corrosiveness by means of water analysis for iron contents. If these waters are sufficiently high in iron to indicate that a corrosive condition exists, a more detailed survey should be made. This program should include both water analysis and test coupons to determine the degree of corrosion occurring, as an aid in deciding whether or not treatment is warranted. In conjunction with the above, the surface equipment should be regularly inspected and tubing caliper surveys run periodically to determine to what degree corrosion has progressed. If treatment of the well is necessary, chemicals should be considered for their economy, simplicity and effectiveness.

APPENDIX

Simplified Field Method for Determining the Iron Contents of Water Samples

To 50 ml aliquot of water sample in a 100 ml test tube, add 5 ml of 4N nitric acid, and 1 ml of bromine water, and 5 ml of 3N potassium thiocyanate. The depth of color that develops will depend upon the amount of iron present.

Add the same amounts of these reagents to 50 ml of distilled water in another 100 ml test tube and then add standard iron solution from a buret until the color equals the intensity of the sample tube. The amount of standard used in this titration directly determines the titer of the iron present in the sample solution. The accuracy is about 2 per cent.

It is important that the bromine water be added to the sample solution first. If the order is reversed the potassium thiocyanate will reduce the bromine before the bromine can serve its purpose of oxidizing the ferrous ion to the ferric state.

The sample should contain between 1 and 10 ppm iron for the best color comparison. Proper dilution can be made with distilled water to achieve an iron concentration in this range. For example, if the iron content is believed to be approximately 75 ppm, the sample should be diluted to 10 times its volume, reducing the con-

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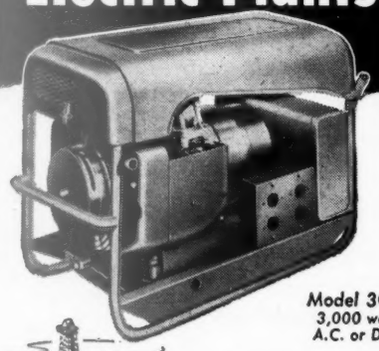
PARKERSBURG MACHINE COMPANY
PARKERSBURG, W. VA.

ONAN *Oilfield*
Electric Plants



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3,000 watts
A.C. or D.C.

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● ONAN oilfield electric plants provide dependable light and power for oil field applications. A complete range of A.C. and D.C. models... all conservatively rated for continuous, dependable service helps you choose the right plant for the job. Lightweight, air-cooled models from 400 to 5,000 watts; heavy-duty, water-cooled, gas-gasoline-driven plants from 3,000 to 75,000 watts. Air-cooled Diesel electric plants 2,500 and 5,000 watts. Water-cooled Diesels from 12,500 to 75,000 watts, powered by IH engines.

Write for Literature

D. W. ONAN & SONS INC.
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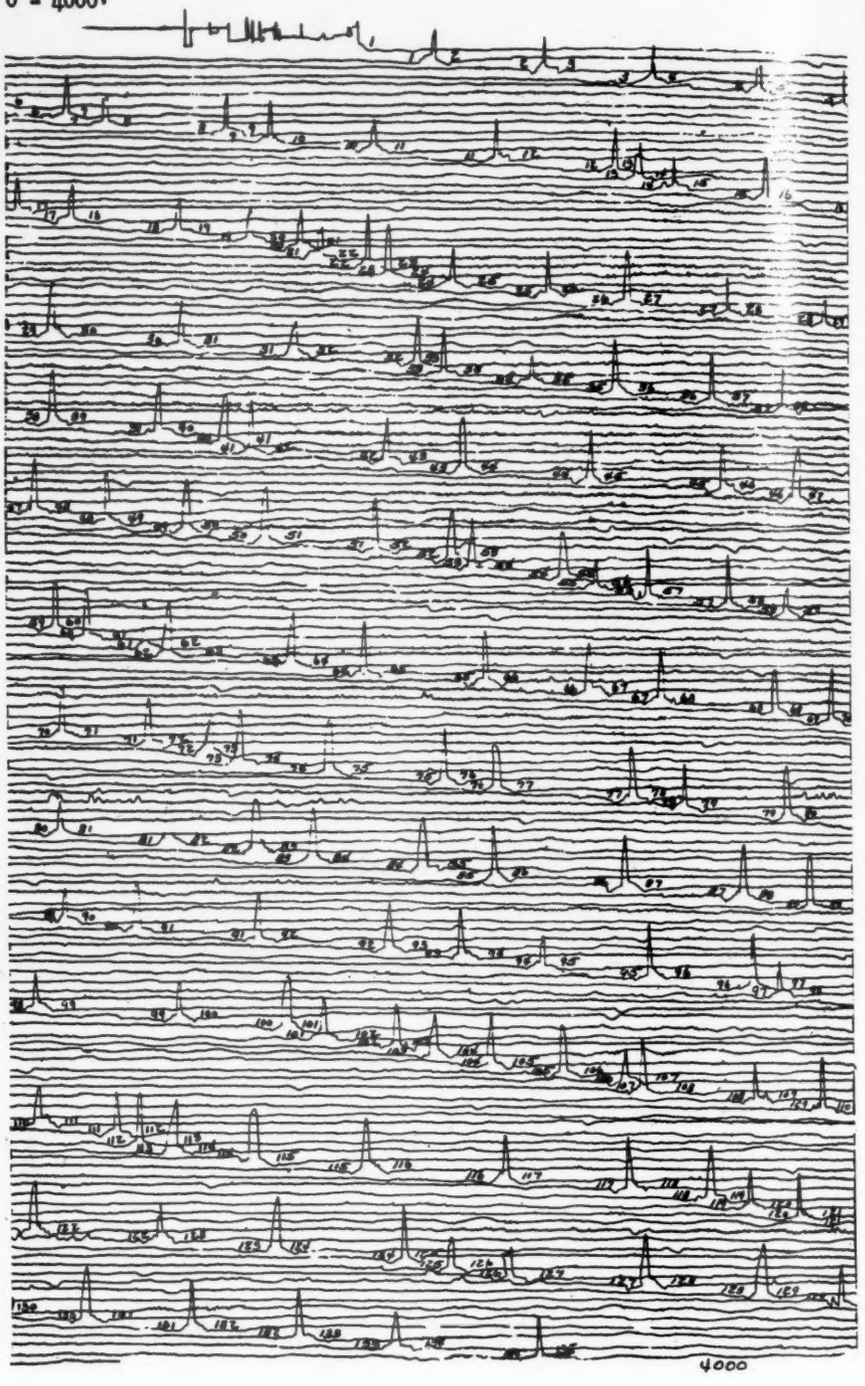
FIG. 5



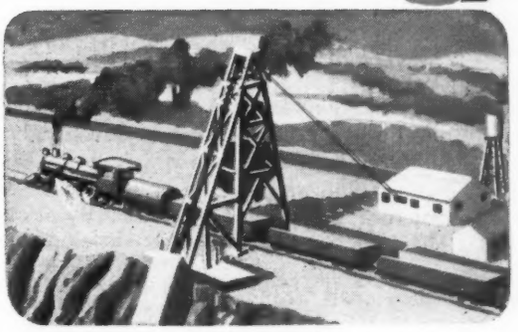
centration to approximately 7.5 ppm before beginning the analytical procedure. This may be accomplished as follows:

Place 25 ml of undiluted sample as measured by a 25 ml volumetric pipette, into a 250 ml volumetric flask. Dilute to the mark with distilled water and agitate for complete dilution. A 50 ml aliquot portion may then be removed for analysis. Remember, however, that the actual value of the iron concentration will be 10 times the value obtained by the analysis of this diluted sample.

During the measurements, the tubes are placed in black paper cylinders to exclude extraneous light from the sides. They are placed over a colorless glass plate, which is in turn over an inclined piece of stiff white cardboard which can be adjusted to optimum illumination. The comparison of solution takes place while looking vertically downward through the solutions filling the tubes. ★ ★ ★

Uniformity

MAINTAINED THROUGH RIGID CONTROLS

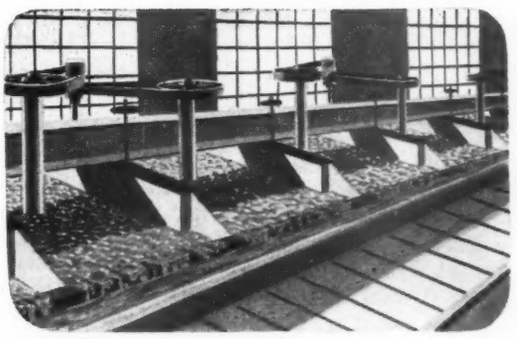


From deep in the Magnet Cove underground mine, Magcobar starts to the oilfields as uniformly mined, high quality barium sulfate . . .

Magcobar

● Every step in the processing of Magcobar is rigidly controlled in order to produce a uniform, chemically inert mud weighting material with a high specific gravity and of the correct particle size so as to be easily suspended in mud. And Magcobar lowers mud costs because fewer sacks are needed. The superior properties of Magcobar are most evident in very high weight muds; however, its use will result in substantial savings in all muds. Look for the Magcobar Dealer sign as your guide to lower mud costs. More than 250 Magcobar Dealers, conveniently located from Canada to the Gulf Coast, are ready day and night to meet your drilling mud needs.

MAGNET COVE BARIUM CORPORATION
ONE OF THE DRESSER INDUSTRIES
MALVERN, ARKANSAS HOUSTON, TEXAS



Then, beneficiated by Magcobar's own flotation process which produces material of exceptional purity . . .

Magcobar gives high weight, low viscosity muds that can be maintained at minimum cost while drilling.

Magcobar
Complete
DRILLING MUD SERVICE
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Compulsory and voluntary, the trend is toward

Cooperative Oil and Gas Operations†

WALACE HAWKINS*

THE wholly owned and operated lease has been, until more recently, the irreducible basis and foundation of the oil producing business. The whole oil industry superstructure rests on this universal base. The function of management in the drilling and producing business has developed around and has been shaped by this essential characteristic. Modern day staff and expert services — geophysical, engineering, technological, tax, accounting, and legal—are geared to a management designed to drill and operate efficiently a wholly owned lease. Heretofore, an oil and gas producer, without a wholly owned and operated lease, has been as uncommon as a farmer without horses and mules, or a carpenter without saw and hammer. My thesis today is that noticeable change in these respects has entered the business on an extensive and wide scale. This change strikes at the fundamentals, exhibits new and different operating tools, and requires new and yet more skillful management.

The impact of joint and co-operative drilling and producing operations is discernible even by those who have eyes and see not. Co-operative wildcat drilling has increased substantially during the last 10 years. Dry hole donations, including those that have been given as well as those received, have increased materially. After all, the giving and receiving of dry hole donations is but one form of co-operation among producers. Increases in such donations have been somewhat in the general proportion of increased costs and depths of drilling. Part-interest, non-producing wildcat acreage is becoming more and more common. The simplest form of unitization is the joinder of separate landowners in a single lease. This practice is on the increase. Part-interest producing acreage compared to wholly owned producing acreage has increased substantially. The average producer is now getting a greater percentage of his daily production from part-interest and jointly operated leases.

The causes and reasons that have produced these results are identified easily. Pooling for exploratory and development wells is made necessary to comply with spacing regulations. When production is obtained on a pooled unit, it becomes, of course, a co-operative producing operation. Secondary recovery operations in most instances necessitate and require concerted action of many operators. This form of co-operation has had striking and surprising results. Pressure maintenance, repressuring, and water flooding projects, in a field where segregated tracts are separately owned and operated, in most instances require the owners to join and participate in the co-operative project. Then, there is the cycling and "recycling" industry. And still another development is that the individual oil producer has recently had imposed on him the duty to prevent gas waste and flaring. These jobs could not be done by operators acting separately.

The only feasible way to prevent such gas waste was by a concert among producers with jointly owned facilities. Here is a plain case of compulsory co-operation. A producer cannot avoid these joint field-wide activities by merely deciding that he will only discover and produce entire fields. The process of securing production is certainly not like the merchandizing business. A merchant can choose his source of supply. It would scarcely be necessary to explain to even a "bureaucrat" why it is that a producer cannot choose to get his oil from wholly owned fields.

Now let us notice reserves. You will be surprised, perhaps, to realize that more and more of your reserves are embraced within part-interest, jointly owned, and unitized properties and fields. Or, to put it another way, you will be surprised that less and less of your reserves are situated in wholly owned leases. You perhaps have not calculated how much reserves were added to your holdings last year as a direct result of drilling done by others. You perhaps have not compared reserves resulting from your own drilling and exploratory operations with reserves produced by the drilling of others.

I make these observations merely to say that it is obvious that wholly owned and operated leases will not keep a producer in the oil and gas business. It is further apparent that co-operative drilling and producing is not merely an academic theory or political philosophy. It is not a luxury that a producer may enjoy as he chooses. Rather, such drilling and producing pattern of operation is an actuality. It is an everyday fact; unitization law or no unitization law. It is here, regardless of the traditional individualism of the oil man, and whether we like it or not. More than that, this "new look" in the oil producing business is likely here to stay.

Consequences and Results

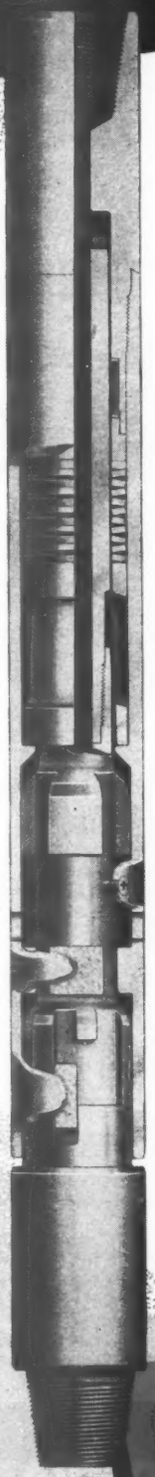
Does this trend toward co-operative and joint operations mean the ultimate elimination of the small and independent producer? The answer is no. More than that, it may be maintained soundly that joint operation is perhaps the independent's best assurance that he can remain in the business and will not be eliminated because of ever increasing financial requirements and hazards. The stakes are too high now for capricious or old style random exploratory drilling. In addition, forbidding geophysical expense is a universal prerequisite to lease buying. The cost of deep wells is prohibitive to some. Necessary and expensive processing plants are beyond the financial limits of many producers. All these mounting expensive and technical operations, requiring expert staff and personnel, of course tend to screen out some who would otherwise enter the business. Undoubtedly joint and co-operative drilling and producing tend to keep the doors open. A co-operative venture divides the hazards; it lowers the level of initial financial outlay to the participants well within the limit of the small operator. Expert and technical staff advice and services are made available on a fractional cost basis. The small producer or part-in-

†Presented at the Spring Meeting of the Mid-Continent District, API Division of Production, Skirvin Hotel, Oklahoma City, Oklahoma, March 29-31, 1950.

*Vice President and General Counsel, Magnolia Petroleum Company, Dallas, Texas.

Another NEW Shaffer Advancement . . .

The SHAFFER JAR SAFETY JOINT



***Combines Jar and Safety Joint in ONE tool!**

***Sets new standards of efficiency, simplicity and compactness!**

Unequalled for Formation Testing, Casing Tests, Diamond Core Drilling, Fishing and similar operations!

WHAT it is!

The new Shaffer Jar Safety Joint combines—in ONE compact tool—*both* a straight-pull Jar and a quick-releasing Safety Joint. If the stuck string cannot be jarred loose, it can then be disconnected for recovery of everything above the mandrel of the Jar Safety Joint. Later, by simply using the recovered portion of the Jar Safety Joint at the bottom of the run-in string, the recovered string can be reconnected with the stuck portion for subsequent recovery operations. The tool embodies operating principles already field-proven in other Shaffer products—and has been successfully used by leading operators under a wide range of well conditions.

WHY it's better!

The Shaffer Jar Safety Joint not only combines two tools in one—thus saving extra costs and conserving space in the string—but it also provides greater safety and efficiency than assemblies of conventional single-purpose tools. Only a *single* pack-off is required . . . only *one* pin and *one* box . . . only a few simple parts that operate as a coordinated unit in place of many duplicated parts that cause multiple maintenance and operating problems. These and other advantages outlined at right mean safer, more efficient, and more economical operation!

MANY APPLICATIONS

The Shaffer Jar Safety Joint is particularly recommended for use with formation testers, casing shoe tests and on fishing jobs. And, although not designed for heavy, high-speed drilling operations, it is extensively used for diamond core drilling and similar light drilling operations.

AS A JAR

The tool strikes a powerful upward blow with simply a *straight pull* on the string. *No torque or rotation of any kind is needed to strike the blow* . . . therefore, there is no interference with operation of other tools in the string. However, full torque *can* be placed in the string if desired for loosening operations—but is not necessary to operate the Jar.

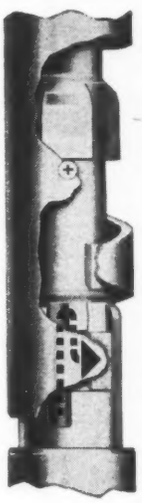
- Any number of blows can be struck in rapid succession—or single blows at any desired intervals—by simply raising and lowering the string. Every time the string is lowered the tool automatically "resets." Raising the string strikes the blow—and blows may be struck *continuously* as fast as the string can be raised and lowered.
- Force of the blow is easily adjusted over a range of 10 to 60 tons in 5 ton steps, so that virtually any desired blow can be struck.
- The tripping mechanism does not depend upon friction for operation and strikes a steady, uniform blow.
- All rotational loads are carried by heavy drive keys—not by threads. Since the drive keys are stronger than the run-in string, any amount of torque can be applied to the string—in *either* direction.

Drive keys remain in locking slot as the blow is struck

AS A SAFETY JOINT

. . . this new Shaffer tool is also superior. Since there are no tight-fitting joints or threads to "force," quick release can be effected whenever desired by simply following a few simple operations in proper sequence.

- Only 1/6th turn is needed to release the Safety Joint, eliminating risk of unscrewing other threads in the string.
- Until the Safety Joint is first made ready to release, *any* amount of torque—in *either* direction—can be applied through it without danger of release.
- At any desired time after release, the Safety Joint can be reconnected *in the hole* for further recovery operations.



Rotating drive keys into unlocking slot releases Safety Joint

***Get The Full Details* on this new Shaffer development from your nearest Shaffer representative. Or write direct!**

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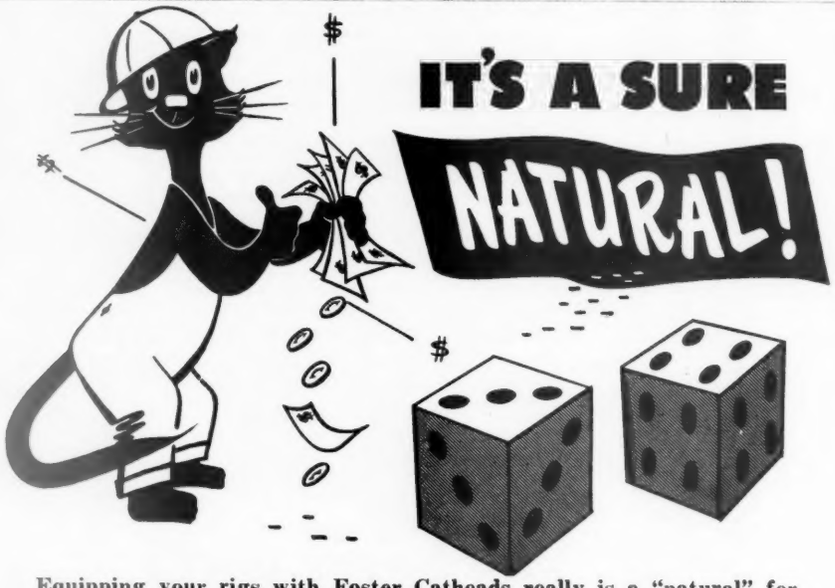
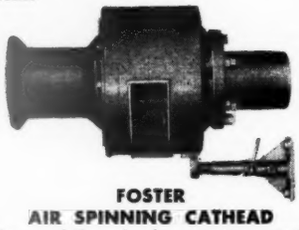
terest producer is thus on equal terms with larger and more financially secure participants.

Should co-operative drilling and producing practice supersede and make obsolete separate individual operations based on the wholly owned and operated lease? Again the answer is no. Co-operative producing operations and joint tenancy are neither designed to displace our present system nor to outmode separate ownership. Simply because air transport is being developed is no reason to predict that transportation by rail, barge, and truck will be abandoned. Simply because spray guns have become common in the painting business does not mean that the paint brush will be displaced any more than atom bombs will dispense with the infantry. Thus it is with co-operative and unitized producing operations. Unitization for unitization's sake cannot be justified. Co-operative operation of separate properties should be used only when such method is best suited and the most effective means to get the required job done. No co-operative producing contract should be signed by a lease owner, neither should his operation be shifted to another, unless the project is clearly feasible, will promote a more efficient operation, will increase ultimate recovery or prevent waste, and will give assurance that such operation will be profitable to both lessee and royalty owner. In short, the joint operation device should be used only when and where it is designed to do and has a reasonable prospect of doing a better and more efficient job. Although it is difficult to determine when and where a co-operative operation can and will do a better and more efficient job, it is certain that producers are becoming more accurate in making this determination. The petroleum engineer and geologist have sharpened their sciences and skills for greater precision and reliability in such matters. Certainly no joint operation or project should be set on foot displacing existing efficient operations unless the joint project is profitable alike to both lessee and lessor. There certainly is no excuse for organizing a committee or association with ponderous and slow moving machinery to do that which an operator acting alone can more efficiently do for himself. The oil man should look upon joint production practice as just another form of operation, a different tool or method to be used when the nature of the job required to be done requires and demands its use.

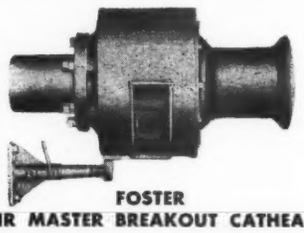


Equipping your rigs with Foster Catheads really is a "natural" for assuring long life and low maintenance for your catheads.
Foster Catheads have earned their place on the finest drilling rigs in the world thru years of specialization in cathead manufacture. This specialization has meant the best in safety, speed, dependability and economy, whether it is on catheads for the shallowest or the deepest wells.



FOSTER
AIR SPINNING CATHEAD

Safer . . . fully enclosed . . . operator can apply any desired amount of power to the pull line.
Faster . . . instant engagement without reducing lineshaft speed.
Dependable . . . 19½" single plate crawl-free friction clutch; recommended for pull up to 12,000 lbs.
Economical . . . smoothness of power makes spinning rope and spinning chain last much longer . . . no adjustments during life of Cathead.



FOSTER
AIR MASTER BREAKOUT CATHEAD

Safer . . . fully enclosed . . . operator in complete control of pull on jerkline at all times.
Faster . . . instant engagement without reducing lineshaft speed.
Dependable . . . 16" triple plate crawl-free friction clutch; amply powered and field proved.
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In addition to the above the Foster Cathead Company manufactures the regular Foster Master, Type B, Breakout Cathead and Foster Spinning Cathead; plus the Foster Midget Master Breakout Cathead and Foster Midget Spinning Catheads for shallow drilling and cleanout rigs.

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Tillery & Parks, Odessa, Texas
R. D. Cloninger, Lafayette, Louisiana

Wholly Owned Versus Unitized Working Interests

It is true that an oil and gas producer with his own drilling rigs, employees, equipment, and an 80-acre lease with production and known reserves, may borrow from his banker $50,000, where the same producer with an interest in a unit operation worth 10 times as much as his 80-acre lease may have difficulty in borrowing half that amount. The reason for this is the inexperience of the banker and his failure to have at hand the necessary technical advice, which would permit him to correctly appraise and value a fractional interest in a unit operation. Bankers and most producers are accustomed to valuing wholly owned and operated working interests and have little experience in valuing unitized leasehold interests. Some operators sit by and permit production worth millions of dollars to go to waste and be forever lost because of a lack of confidence in their ability to translate the value of production from their wholly owned leases into the form of a fractional interest of equal value in a unit operation offered them in lieu of or as consideration for their leases. I have seen suspicion and distrust alone absolutely destroy a genuine profit making joint venture proposal. Distrust and suspicion are rather expen-

It doesn't have to be this way...

"WHERE IN THE *!#* ARE YOU, JOE. WE GOT TO HAVE THAT LATCH FOR THE ROD ELEVATORS."
"JOE, THIS IS PETE ON THE R. TAYLOR. THIS COLD SNAP HAS PARAFFINED THE LEAD LINES HERE PLUMB SOLID. WHEN CAN YOU GET THE GANG OVER TO BUST 'EM OUT?"
"JOE, WE CAN'T GET IN TO PULL GLENNIS 12 TODAY —WE'RE STUCK ON THE AUSTIN."

It can be like this!

"NOTHING TO IT, JOE! WEATHER DOESN'T BOTHER US A BIT, SINCE WE GOT THOSE KOBE FREE PUMPS. YEH, SOLUBLE PLUGS CLEANED PARAFFIN OUT OF TAYLOR 7 AND 8 SLICK AS A WHISTLE. WE'VE NEVER HAD IT SO EASY."
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Problems created by weather or mechanical failures are simplified . . . and far fewer, when your lease is Free Pumped.

One man can surface the bottom hole Free Pump and run in a new one. There's no waiting for equipment; no delays due to roads or weather. Paraffin, in both lease lines and well tubing, is easily and quickly removed with Kobe soluble plugs.

In these ways Free Pumping makes your pumper independent of outside help, gives you fewer annoying problems to solve, and more time to plan your work.

If *you* want to eliminate the *costs of confusion*, your nearest Kobe representative can tell you how inexpensively your properties can be equipped with Free Pumps. Why not call him . . . today?

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sive luxuries. Many of us may be content to lambaste joint and co-operative operations rather than to master the necessary and essential technique required for the fair and successful negotiation of a joint operating contract and the establishment of a joint producing enterprise.

Some operators argue that they prefer to produce by means of separately owned leases rather than jointly with others because they believe they are better and more efficient operators than their neighbors. Some complain that joint operation will involve excessive overhead, etc. The answer to that objection is easy. Every operator in a joint operation has a voice and right to vote equivalent to his interest in the joint operation and in exact proportion to such interest. If some operator can cut overhead and reduce the lifting cost and is more efficient than his brethren, I daresay he will get the job as operator. Self-interest of the other operators would compel such action.

It is argued, too, that a lessee in joining a unit loses the privilege and pleasure of operating his own properties. In any unitized operation some operators must forego the privilege of directing manual or physical operations. No unitized operation requires an operator to abandon and forego his managerial function. He must still manage. Instead of managing wholly owned leases, he must manage part-interest leases. His management then is a joint one and not a separate one. He must, if he can, impose his managerial genius on the unit operators' committee, rather than on his producing superintendent. Too, it is well to remember that, while in some joint operations a particular operator must give up the actual direction of producing activities on his leases, yet in others he must act as operator and direct activities not only on his own properties but on the properties of others. In the long run it could balance out. The truth is that about all the difference there is between wholly owned and operated lease operations and unitized operations is that the producer merely exercises a different form and kind of management. In the first instance it is manual and complete management, while in the second instance it is joint management. In the first case he is president and board of directors, while in joint operations he must often be satisfied with merely sitting on the board of directors.

I shall not enumerate the many savings, profits and other benefits which joint operation has over wholly owned and operated lease operation. I have picked out the item of management and control because that is the mate-

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Uniform hardness, straightness and concentricity are assured in CP Drill Collars because of the exacting methods employed in their manufacture.

Forged from chrome-nickel alloy steel, CP Drill Collars are overall hardened by vertical quenching to assure straightness and freedom from distortion strains . . . bored on machines recently designed and developed exclusively for Chicago Pneumatic, which produce mirror-like finish bores, with a straightness and alignment never previously possible . . . finish turned on the outside concentrically with the bored hole.

Connections on drill collars are furnished to customer's specifications. Popular size drill collars are carried in stock for immediate delivery, and other lengths, up to 55 feet, can be supplied on special order.

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You can't beat the WECO FIG. 400

You just can't beat the Fig. 400 for versatility around the drilling rig. Designed for the tougher services required on mud, steam, water, oil and gas lines . . . lines that are made-up and broken-out most frequently . . . that carry abrasive fluids at high pressure with lots of vibration . . . the Fig. 400 withstands more abuse than any comparable union in these services. It makes-up fast, breaks-out quickly . . . seals perfectly every time with just a few hammer blows. The thicker wall sub ends resist distortion . . . give it greater strength with less weight.

Standardize on WECO Fig. 400 for the best connections in drilling and production service. Available in sizes 2" through 10"; 4000 lb. test pressures. All parts interchangeable.

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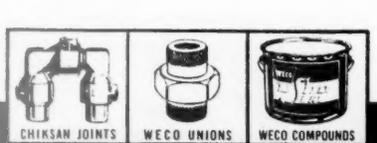

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Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment

rial stumbling block and obstacle most often encountered. However expensive, the traditional oil man wants a lease to walk around on. It is difficult for him to believe that one may qualify as a producer without a wholly owned and operated lease. Industry progress as well as the public interest demands that in some cases the "sole owner" luxury yield to a stockholder status.

Lease Royalty Versus Unitized Royalty

Here I shall not discuss the relative virtues and value of a 40-acre lease royalty compared to a fractional interest royalty spread throughout an entire field or pool. I will not compare a one-eighth royalty on gas and oil with a one-eighth unitized royalty, which includes one-eighth of the oil and gas and plant products. Unitized royalty should always have greater value than lease royalty. I concede that a lease royalty is often more tangible to the uninitiated than a unitized royalty.

I am concerned, however, with the question: When and how should producers present a joint or co-operative producing proposal to royalty-owners? How and when should operators discuss repressuring, pressure maintenance, secondary recovery, or any other co-operative and unitized project with royalty owners? The decision ought not to be a difficult one. Operators now are daily making the identical decision rather automatically. Operators are accustomed to securing royalty owners' consent to a pooling agreement. This is unitized operation on a small scale. Landmen and producers are familiar enough with the considerations involved to present a pooling matter fairly and adequately to a royalty owner. An employe who negotiates a pooling contract with a royalty owner is fully acquainted with the benefits and detriments and can tell the lessor what he may expect. The virtues of a pooled royalty as compared to lease royalty are no longer a mystery.

Just so with a co-operative or unitized operation — the operators cannot possibly have anything to present to royalty owners for their consideration until the operators themselves have matured their program to a definite plan and have agreed to the terms of such proposed operation. I have yet to be taught that simply because joint operation of leases is substituted for wholly owned and operated lease operation that thereby royalty owners are entitled to invade the operator's prerogatives and become operators as well as royalty owners. When a joint operation is thus evolved

by the operators and its terms stipulated, a definite proposal to royalty owners can then be made and not before. There is nothing to discuss with royalty owners until this is accomplished. A joint operation covering a field or a particular producing horizon presents, of course, more complicated matters for consideration by the royalty owners than a simple pooling agreement. I do admit that in most cases expert technical advice is needed to safely compare a unitized royalty with a lease royalty.

Presentation to royalty owners may be done most effectively as a group. Operators should be prepared to furnish royalty owners all information, statistics, figures, maps and calculations which may be considered material or useful to their full consideration of the proposal. Often royalty owners become concerned with matters other than the volume, amount, value and payment of their royalty. An operator is merely borrowing trouble in discussing matters in which the royalty owner has no legal or contractual interest. After all, the royalty owner interest and concern is limited to the effect of the joint operation proposal on his royalty. No problem or matter for decision need be submitted to the royalty owner which the lease commits to the lessee. Operators can well suggest that royalty owners employ competent geologists and engineers for advice and consultation. Such professional advice and consultation should be maintained by the royalty owners on a continuing basis.

No operator should expect the royalty owner to consent to and acquiesce in a joint operation except upon the showing that such operation is profitable and beneficial to him. Lessees and operators cannot unitize the leasehold interest for joint operation upon terms which ignore or disregard the effect upon the royalty interest. In some cases operators may be required to change or add to the plan of unitization obligations which royalty owners legitimately demand.

Oftentimes a royalty owner may become recalcitrant because he desires to exact other and different terms from the operators than those given royalty owners similarly situated. In many instances where the operator cannot comply with such demands, the joint operation may be commenced and continued consistent with conventional operation on the non-consenting lessor's premises. In that instance, after operation for some period of time, the non-consenting royalty owner may then elect whether he will take the royalty from his lease or whether he will take his unitized royalty. If the unitized operation anywhere near approaches what is expected of it, the non-consenting royalty owner seldom has any difficulty in accepting unitized royalty. While the group method of securing royalty owner's consent to the co-operative program is often more efficient, yet in some instances each operator will take the burden and responsibility of securing the consent of his own royalty owner. One thing may be said, however; operators may well avoid piecemeal and duplicated negotiations, high-pressure salesmanship, and changing and uniformed negotiators. A well planned and engineered co-operative producing project eliminates any excuse for an unfair and unjust proposal to royalty owners. The job of presenting to a group of inexperienced royalty owners a complicated program for joint operations which may change from time to time is one requiring well trained and informed negotiators. It is a job demanding utmost good faith. No one may expect good results except on the basis of a full and fair disclosure. The royalty owner must have the means and full opportunity to compare the value of the unitized royalty offered him in exchange for his lease royalty.

Conclusions

The conclusions to be drawn from my remarks are simple ones:

1. Joint and co-operative methods of drilling and producing are justified and are now soundly established in the oil business. It may be said that so-called compulsory unitization laws contributed little if anything to this result.

2. Such pattern of operation is neither designed to destroy nor is it capable of destroying other methods of operation. Joint operation should be employed only where such method is more efficient, prevents waste, increases ultimate recovery, and is best designed to produce a profit to operator and increased royalty to the royalty owner.

3. The technique of negotiating a unit operation as between operators, the ability to fairly appraise unit values, expertness in allocating production fairly and equitably between separate tracts, and skill in exercising managerial rights and privileges on an operating committee must be mastered by all producers. Operators must become experts in negotiating co-operative producing with royalty owners. I might add that royalty buyers must add a new skill to their profession.

4. No dire results or bad consequences appear on the horizon because of ever increasing co-operative drilling and producing operations.

References

"The Negotiation and Preparation of Unitization Agreements," R. M. Williams, *First Annual Institute on Oil and Gas Law*, Southwestern Legal Foundation, Dallas, Texas, p. 43; "The Formation and Operation of Co-operative Projects in Secondary Recovery," D. V. Carter, paper presented at annual meeting of American Petroleum Institute, 1947; "Pooling and Unitization of Oil and Gas Leases," 46 *Mich. L. Rev.* 311; "Unit Operation of Oil and Gas Fields," John C. Jacobs, *Yale Law Journal*, May, 1948; "Implied Covenants, Conservation and Unitization," Maurice H. Merrill, *Oklahoma Law Review*, Vol. II, p. 469, 1949; "Unit Agreements and Unitized Operations: A Review of their Past and some Speculations as to their Future: With Particular Comments on Federal Unit Agreements," Dean Terrill, *First Annual Institute on Oil and Gas Law*, Southwestern Legal Foundation, Dallas, Texas, p. 1; *Antitrust Laws* et al v. Unit Operation of Oil or Gas Pools, Robert E. Hardwicke, American Institute of Mining and Metallurgical Engineers, 1948.

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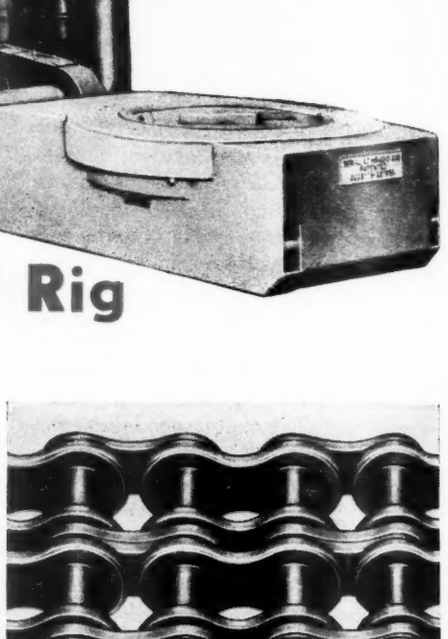

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NEWS

France's 1949 Production Is Higher Than 1948's

French production totaled 415,220 bbl of crude oil in 1949, as compared with the 361,350 bbl produced in 1948. An additional 129,735 bbl were produced in French Morocco. Seventeen geophysical crews explored for possible oil and gas-bearing structures in France and French Overseas Territories in 1949. During last year 178 wells were completed in the French Union, of which 49 were producers and 5 were gas wells.

Imports increased 32,514,200 bbl above the amount imported in 1948. Crude runs to still increased 39 per cent from the previous year, and domestic consumption of manufactured petroleum products were up 19 per cent. Expanded petroleum products were mainly due to the increased allocations of steel to the industry in 1949, which made possible the reconstructoin of refineries destroyed during World War II.

Book on Secondary Recovery

The American Petroleum Institute has announced the publication of "Secondary Recovery of Oil in the United States," Second Edition.

The new version of the standard work describes the latest and most efficient methods for increasing the recovery of petroleum, and presents tables, charts, and diagrams never before published. In addition, the volume includes much material from the 1942 edition and later supplements.

The 838-page study consists of seven parts, each devoted to some important phase of secondary-recovery operations. They are: (1) General Considerations, (2) Criteria for Determining Oil Fields' Susceptibility to Secondary-Recovery Methods, (3) The Development and Operation of Secondary-Recovery Projects, (4) Description of Secondary-Recovery Operations in the United States, (5) Mining for Petroleum, (6) Bibliography on Secondary Recovery, and (7) Addenda.

Data were prepared by the Standing Subcommittee on Secondary-Recovery Methods of the Division of Production. The preface is written by Jake L. Hamon, API vice president for production, and Paul D. Torrey, chairman of the subcommittee, prepared the foreword.

Priced at $8.50, the volume may be obtained from Lacey Walker, secretary, American Petroleum Institute, 50 West 50th Street, New York 20.

At top left is F. W. Borden, general production superintendent, and L. M. Combs, assistant production superintendent, at the Barnsdall division of Sunray's No. NCW 2 in Pico Canyon, Newhall, California. The well is said to be the deepest pumped one in the world.

Deepest Pumped Oil Well

Sunray Oil Corporation's well NCW2, which is shown in the accompanying photograph is reported to be the world's deepest pumped oil well. It is situated in Pico Canyon, Newhall, California. Going ever deeper in the quest for oil, newer and improved methods of production are required. The Pelton long stroke hydraulic pumping jack is in operation on the world's deepest pumper. The $1\frac{1}{16}$-in. bore pump set at 11,614 ft is actuated through a tapered sucker rod string of 1-in., $\frac{7}{8}$-in. and $\frac{3}{4}$-in. rods and producing 85 bbl of crude per day. Although the pumping unit has greater capacity, it is now pumping all of the oil available at its present setting.

Plan 1951 Meet

The Standardization and Standing Committees of the Division of Production of the American Petroleum Institute will hold their midyear meeting in the Brown Palace Hotel, Denver, Colorado, May 28 through June 1, 1951. Scheduling of the meeting was announced by Carl A. Young, director of the production division.

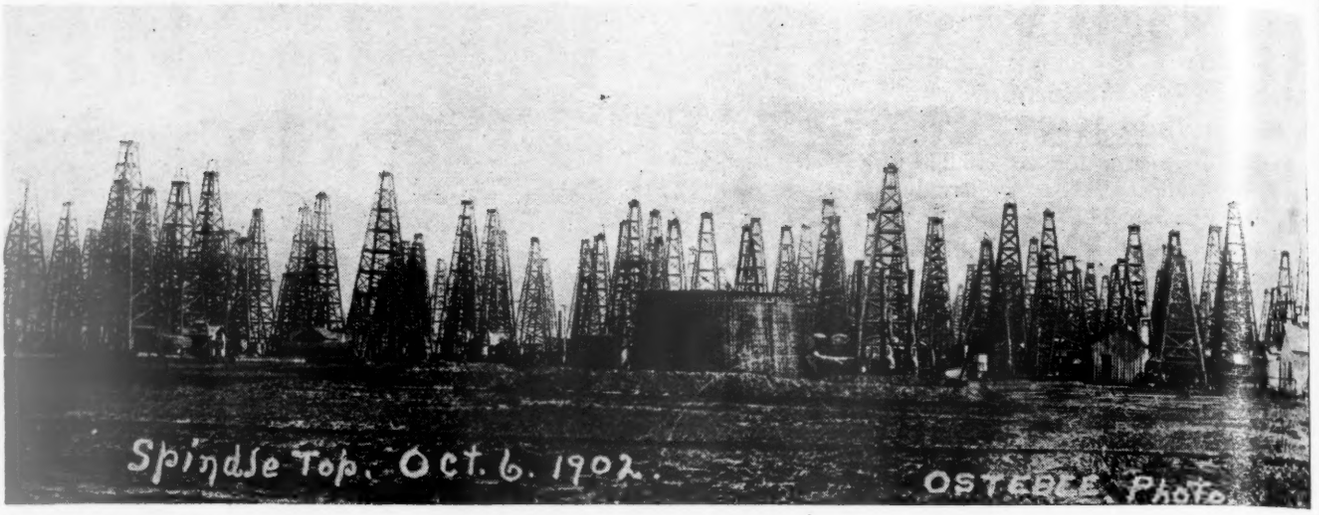
Venezuelan Production

The Colon Development Company, Ltd., has reported that it produced 428,964 bbl of crude oil in Venezuela during the five weeks ending October 2, 1950.

Saudi Arabian Output

Crude oil production in Saudi Arabia during September amounted to 17,846,128 bbl, or an average of 594,871 bbl per calendar day, it was announced by the Arabian American Oil Company. This compared with 18,160,748 bbl produced in Saudi Arabia in August.

Crude oil production for the first nine months of 1950 amounted to 141,852,234 bbl, an average of 519,605 bbl per calendar day.



Spindletop 50 Years Old

The 50th anniversary of the discovery of the Spindletop field (see photo above) near Beaumont, Texas, is being celebrated in January of next year. The discovery well, the Anthony F. Lucas gusher, blew in making an estimated 100,000 bbl of oil per day from a depth of 1160 ft at 10:30 a.m. January 10, 1901. In the 9 days it ran wild, it produced 800,000 bbl. By the end of 1901, 585 oil and leasing companies were doing business in Beaumont, and there were 138 producing wells on Spindletop Hill. One could walk from end to end of the field on derrick floors.

Consulting Firm Set Up

Dr. R. G. Hamilton and L. G. Chombart have announced the formation of a new consulting firm, under the name of Hamilton and Chombart, with headquarters in the Wright Building, Tulsa, and representation in Wichita, Kansas, Oklahoma City, and Dallas.

The firm will specialize in the analysis and review interpretation of electric logs, services pioneered by Hamilton's former organization.

Both men are active in numerous technical organizations and are widely known as authorities in well-logging and interpretation. Born in France, Chombart graduated in mines and metallurgy from Ecole Centrale des Arts et Manufactures of Paris, France, with highest honors. Chombart was an officer in the French Reserve and an engineer in a steel plant before joining Schlumberger in 1937.

Shell Seeks Oil Under Sea

Shell Oil Company is attempting to take oil from under the China sea in the jungle swamps of Brunei off the Island of Borneo. Jetties run from the beach 800 ft into the ocean. Wells are drilled through the water and submarine oil-loading lines, three miles long, take the crude oil inland. The work is still in the experimental stage, but if the tests prove the existence of oil in quantities, the seabed wells will be developed.

Tests are being made off the South China Sea coast near the town of Seria where a rich oil field yields 3,000,000 tons of oil a year. Shell engineers began rehabilitation of the field soon after reoccupation from Japanese forces in 1945, and in March 1946 the first tanker left with crude oil for refining in Australia. Production has increased steadily since that time.

New York Nomads Golf Party. For the second time this year New York Nomads had a golf party. The president's cup, which is given each year to the Nomad with the lowest gross score, was presented to John Evans (far left) by Henry McAdams, president. Below, exhibiting the prizes, are: Kneeling, McAdams, J. G. Buss, Evans, and Ashley Moore; standing, W. Campbell, C. A. Sanders, W. H. Busold, H. Maland, Norman Gronna, and D. Beaver.

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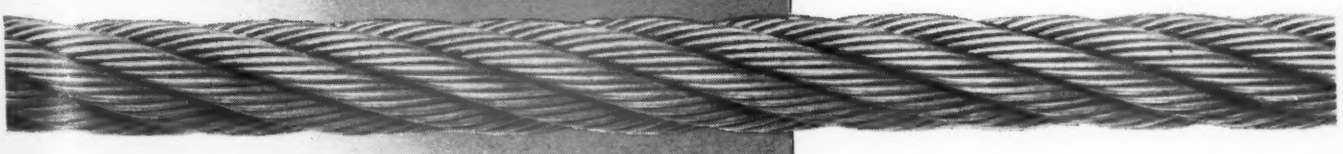

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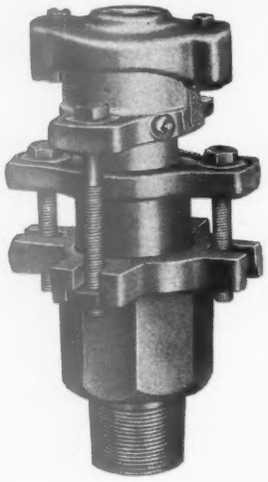

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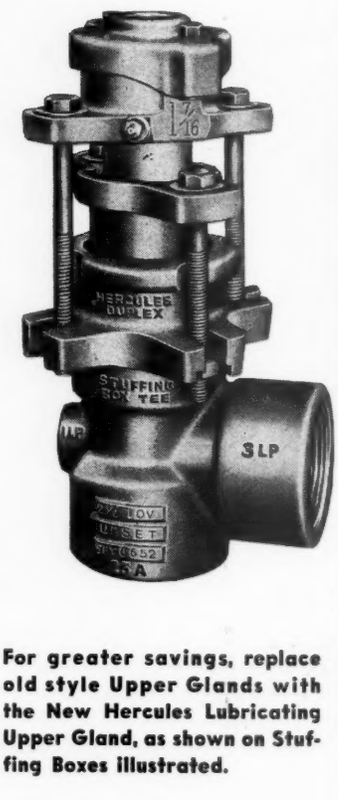

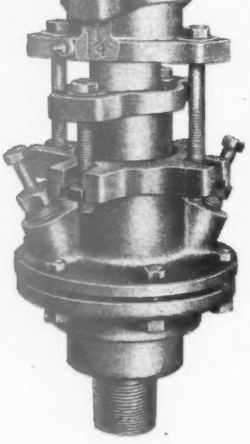

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Map of Central Wyoming Area Published

The Geological Survey has published a new geologic map of the Lander area in the Wind River Basin of Central Wyoming. Nine anticlinal folds or domes, on 5 of which are oil fields, are shown on the map. More than 9000 ft of rocks of Mesozoic and Tertiary age, divided by the geologists into 15 formations, are present.

The report on the Lander area is printed on 2 sheets, each measuring 41 by 54 in. Sheet 1 includes a geologic map, 6 cross sections, 2 index maps, and a table of selected oil well data. The map shows the geology of an area of about 700 sq miles. Titled "Geology of the Lander Area, Central Wyoming," by R. M. Thompson, M. L. Troyer, V. L. White, and G. M. Pipiringos, the map may be purchased from the Distribution Section, Geological Survey, Denver Federal Center, Denver Colorado, at $1 a set.

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Texas' November Oil Flow Cut 26,808 Bbl Daily

The Railroad Commission has ordered Texas to cut its daily production 26,808 bbl during the month of November, making a total of 2,712,705 bbl a day. New wells added make total output almost the same as October's. As November has one day less than October, the Commission took a day off producing schedules. Most pools will operate 21 days in this month. East Texas will have a 20-day schedule, as did Fullerton in Andrews County. Willamar field, Willacy County will produce 12 days. Commission engineers recommend that Scurry, Border, and Kent Counties cut wells from 160 to 65 bbl a day because of declining pressures.

Crowell Offices Moved

Alec Crowell, Natural Gas Associated Consultants, has announced a change of address from the Carondelet Building to the California Building. Offices are situated in New Orleans, Louisiana.

Gulf To Test Cotton Valley Horizon

Gulf Refining Company is trying for deeper producing sands in the Pine Island field of Caddo Parish, north Lousiana. The test will be the No. 279 Caddo Levee Board "N". Objective depth of the test is the Cotton Valley Horizon.

Clarify API Patent Policy

In order to clear up any possible misunderstanding of the Institute's patent policy in connection with API standardization of oil field equipment, Frank M. Porter, president of the American Petroleum Institute, has issued the following statement:

"As early as May 1941, the central committee on standardization of oil field equipment announced the following policy in respect to all API specifications:

'Nothing contained in this specification is to be construed as granting any right, by implication or otherwise, for manufacture, sale, or use in connection with any method, apparatus, or product covered by letters patent, nor as insuring anyone against liability for infringement of letters patent.'

"This policy has been consistently followed in the formulation of all API specifications and no preference or indication of superiority, acceptance or approval of one manufacturer's product over that of another is to be implied from the adoption of any API specification."

...y comparison, oil consumption averaged 4,770,000 barrels daily in 1941. To-day's ... 1945, the peak year of World War II.

Pipe In Short Supply?

Otis Tubing Caliper Determines Extent of Internal Corrosion

Wire Line Operations Permit Surveys Under Pressure, Without Killing Well or Pulling String For Surface Inspection

Faced with a possible shortage of tubular goods, many operators are keeping a closer check on the internal condition of tubing and casing in wells located in corrosive fields.

Tubing corrosion surveys by Otis Pressure Control are made under full shut-in well pressures and do not necessitate killing the well or pulling the string for surface inspection. Experienced Otis Caliper crews, including an engineer and wire line specialist, are available for immediate dispatching from 11 Otis offices. Crews can submit a preliminary interpretation of the general condition of the string and a list of bad joints immediately after the well is calipered. Otis crews have a complete set of calipering instruments to survey all standard sizes of tubing from 1½-in. to 4-in., and casing from 5½-in to 8⅝-in. As many as 30,000 feet of tubing can be surveyed in a single day's operation. Literature containing complete details is available from any Otis office.

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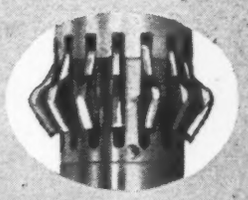
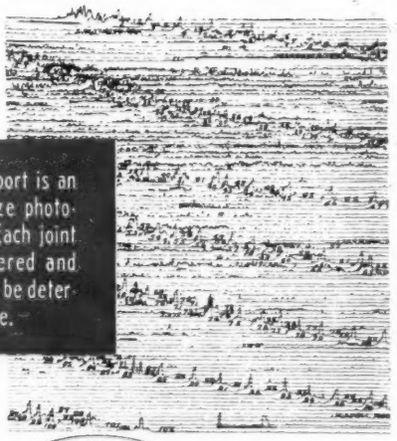
Closely-spaced spring-loaded feelers press against the inside area of the pipe wall; when a corrosion pit is encountered, direct action causes a rotating stylus to plot the location on a metal chart inside of the Caliper. The depth of the pits determines the extent of the log marks.



Included in each well report is an easy-to-read, double-size photostat of the Caliper log. Each joint in the string is numbered and badly corroded joints can be determined at a glance.



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WHAT'S DOING IN DRILLING

Sinclair Well Flows 509 Bbl of Oil an Hour

Garvin County, Oklahoma, is the scene of an especially good Sinclair Oil and Gas producer. The No. 1 Moore-Mullican Unit was drilled to a total depth of 7170 ft, and plugged back to 7051 ft, with perforations between 6980 to 7007 ft. It flowed 509 bbl of oil in 24 hr from the first Gibson sand. Flow was through a ¾-in. choke for 7 hours, and through a ½-in. choke for 7 hours, and through a ⅝-in. choke for 14 hours. Gas volume was 575,000 cu ft a day and gravity of the oil 41 deg.

Humble Extends Pool in Scurry County, Texas

Humble Oil and Refining Company and Sun Oil have extended Strawn lime production on the southwest flank of the Kelley-Snyder pool of Scurry County, Texas, 1¼ miles southwest. The extension well is the No. 1-A Arledge, which flowed 229 bbl of 39.1 gravity oil. Production is from 7625 to 7684 ft.

New Well in Alabama Field

Indications are that Magnolia Petroleum Company has a good producer in the East Gilbertown field of Choctaw County, Alabama. After drilling to 3410 ft and casing hole with 7-in. pipe to that point, the operator perforated in the Eutaw zone at 3346-55 ft. A drill stem test was made and the well swabbed 160 bbl of oil in 16 hours or at the rate of 240 bbl of oil per day.

Deep Zone Opened

A new deep producing horizon has been opened in the Abbeville field of Vermillion Parish, Louisiana, by Continental Oil Company. The company's No. 1 Noah P. Harrington, et al, flowed 59 bbl of condensate daily through a 12/64-in. choke plus 3,000,000 cu ft of gas from 11,543 to 11,552 ft.

Nebraska Area Broadened

The Dorman area in Cheyenne County, Nebraska, has been extended with Ohio Oil Company's Beyers No. 1. The well tested 1700 ft of oil.

Mississippi Deep Test To Go Below 18,636 Ft

George Vasen, independent operator, is planning to continue deeper at his No. 1 Tung Oil Corporation in Stone County, Mississippi. At last report the well was coring below 18,636 ft in an undetermined formation. Operators have now begun using a 50-ft core barrel, which is making it possible to speed deepening operations. It now takes about 36 hours to make a round-trip recovering 50-ft cores. The No. 1 Tung Oil is within 98 ft of the world's second deepest hole, which was drilled in California by Superior Oil Company to a depth of 18,734 ft.

Canyon Reef Lime Extended

Canyon reef lime oil production has been extended in Runnels County, Texas, with completion of the Robertson-Puckett, Inc., No. 1 T. B. Poe. The well flowed 137 bbl of 42 gravity oil in 8 hours, through ¼-in. tubing choke for a calculated daily potential of 412 bbl. Production is from 3497 ft to 3510 ft.

Officers of American Association of Oilwell Drilling Contractors for 1951. The following officers were elected at the tenth annual meeting, held in Tulsa, Oklahoma, recently: Above are shown some of these officers following installation ceremonies at a luncheon in the Hotel Tulsa. They are left to right, W. W. Cline, San Joaquin Drilling Co., Los Angeles, California, vice president for California; C. H. Todd, R. W. Rine Drilling, Wichita, Kansas, vice president for Central Mid-Continent; H. W. Davidson, Davidson Drilling Company, Odessa, Texas, vice president for West Texas and New Mexico; D. E. McMahon, Nicklos Drilling Company, Houston, Texas, vice president for Gulf Coast; J. V. Dunbar, Dunbar Drilling, Salem, Illinois, vice president at large; A. W. Thompson, Thompson-Carr, Inc., Houston, Texas, president; J. Doyle Settle, secretary; Brad Mills, executive vice president; Marion S. Church, counsel; and Louis A. Beecherl, McDaniel & Beecherl, Dallas, Texas, treasurer. Not shown are: Harold M. McClure, McClure Drilling, Alma, Michigan, vice president for Cable Tools; Will I. Lewis, Will I. Lewis Drilling, Mt. Vernon, Illinois, vice president of Illinois, Michigan, and Kentucky; Charles W. Glasscock, Glasscock Drilling, Shreveport, Louisiana, vice president for Cretaceous and Tertiary Basins; H. A. True, Jr., Reserve Drilling Company, Casper, Wyoming, vice president for Rocky Mountains, and J. J. Harrigan, Standard Well Service, Oklahoma City, Oklahoma, vice president for well servicing.

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Superior Oil Co.'s Pacific Creek Unit No. 1, near Rock Springs, Wyoming, drilled to a world's record depth of 20,521 ft. Ultra-deep wells such as this open up entirely new horizons in exploration and drilling for oil.

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3. **After retardation,** a heavy slurry of UNAFLO hardens normally to form a dense seal.

To be sure...always protect *your* investment with UNAFLO!

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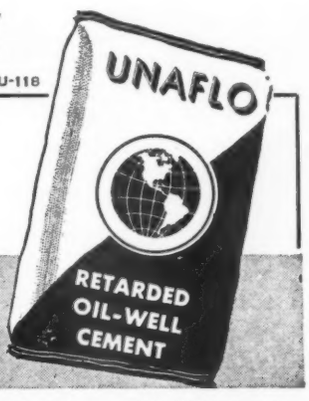

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

Stanolind Completes Confirmation Well

Stanolind Oil and Gas Company has completed its west confirmation well to the Kingston field of Adams County, Mississippi. The well, which is producing from 6488-90 ft, flowed 53 bbl of 36 gravity oil per day. Tubing pressure was 460 lb with gas oil ratio of 200 to 1.

Ashland Seeks 2nd Well

Ashland Oil and Refining Company is seeking a second producer in the Southeast Waterloo pool of Oklahoma County, Oklahoma. It is staking the No. 1 Mabel Peters for a north offset to the Ashland No. 1 Shannon, that opened the field with Bartlesville production at 5971-90 ft.

Venezuelan Well Drilled

Pancoastal Oil Company recently reported completion of a new well in the Ruiz oil field in eastern Venezuela. The well, situated at the western border of the field, was drilled to a depth of 2964 ft in Chaguaramus sands. On initial tests, it flowed 414 bbl daily of 38.9 gravity oil through a 5/16-in. opening in the pipe. Pancoastal and Venezuela-Atlantic Refining Company own the Ruiz field.

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Arkansas Field Proved

C. H. Murphy and Company has dually completed at the No. 1 Concannon, to prove the new Tubal field on the Columbia-Union County line in Arkansas. The Concannon was perforated at 9286-90 ft in the Smackover and tested 79.75 bbl of distillate a day through a ¼-in. choke, with gas-oil ratio of 9850-to-1. Cotton Valley was perforated at 8024-44 ft and tested 144 bbl of oil a day with gas-oil ratio of 450-to-1, through a 1.8-in. choke; crude tested 46 deg gravity.

Ohio Has 2 New Gas Wells

Zane Oil and Gas Company has brought in a good gas well along the west side of the Baker pool in Perry County, Ohio. The No. 3 L. J. Curry gaged 1,300,000 cu ft natural gas from Clinton sand found at 2964-98 ft.

Ohio Fuel Company's No. 2 Glen Schooler has drilled the third Clinton sand gas well in the new pool in Knox County. The well was drilled through the upper sand, logged at 2841-59 ft with a gage of 1,225,000 cu ft natural.

Carter Adds Well To Panther Creek

Carter Oil Company has reported a good producer in its No. 1 Harris, Garvin County, Oklahoma Panther Creek pool. Now flowing on test from plugged back depth 7624 ft, the well flowed 181 bbl of new oil in 11 hours from the Gibson sand, with gravity 40.8 corrected, and gas-oil ratio 1128-1. Tubing pressure was 100 lb.

Drilling Firm Moves Office

The Southeastern Drilling Company has moved its general offices to the ninth floor of the Employer's Insurance Building, Akard and Young Streets, Dallas, Texas. W. P. Clements, Jr., will be in charge of the Dallas office, with W. E. Armentrout as office manager. Dallas mailing address will be P. O. Box 6266, Terminal Station Annex.

The company stated that this change is being made so that it may efficiently handle the 80 rotary rigs it is moving into West Texas-New Mexico area. W. N. Gray is the drilling superintendent. His offices are at 1305 N. Colorado Street, Midland, Texas.

Operations will continue in the Mississippi-Alabama-Louisiana area and will continue to maintain offices in the Tower Building in Jackson, Mississippi, as a regional office with I. P. LaRue, Jr., in charge of the office. Drilling superintendent for that area is H. M. Scallorn whose headquarters will be in Brookhaven, Mississippi.

Sinclair Brings in Oklahoma Producer

Sinclair Oil and Gas Company has completed a good producer in the Ara pool of Stephens County, Oklahoma. It is the No. 1 Minnie Neal, which was drilled to a total depth of 5595 ft, producing from the Pickens sand between 5116-59 ft. It swabbed 265 bbl of 32.2 gravity oil in 8 hr through tubing. With the oil was 125,000 cu ft of gas for a gas-oil ratio of 157 to 1. The well is an east extension to the pool.

Well Flows 426 Bbl Daily

Another oil and gas producer has been completed by Shell Oil Company in the Beckham County, Oklahoma, sector of the Elk City field. Its No. 1 E. Kelly "C," plugged back depth 10,230 ft, flowed 426 bbl of oil in 24 hr through 22/64-in. choke, with 2,917,000 cu ft of gas.

Corporate Name Changed

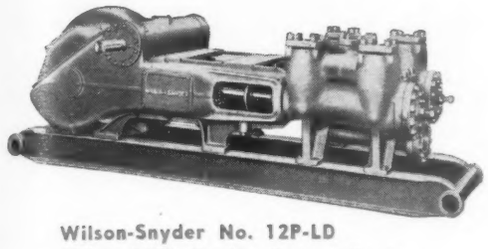
The Union Sulphur Company, Inc., has changed its corporate name to Union Sulphur and Oil Corporation. The new name gives recognition to the fact that in recent years the company's principal activity has been the exploration for and production of crude oil and natural gas. The change in name involves no change in the company's policies, H. F. Whiton, president, announced. The steamship operations and other activities will continue as heretofore. The company's address will remain at 33 Rector Street, New York, New York, according to Whiton.

Amerada Drills Third Well For Terry County Field

Amerada's Willard No. 1 eastern offset to the discovery well in the Adair reef area of Terry County, Texas, is the third well for the field. This newest well is the first to show production from the reef. It was plugged back to 8565 ft for completion after drilling to 12,465 ft in the Devonian. The well flowed 623 bbl of 43.3 gravity oil daily in 12 hr through ¼-in. choke after washing with 500 gal of acid. Gas-oil ratio was 478-1.

Superior Tests New Well In Ringwood Pool

Superior Oil Company has signs of a good producer in the Ringwood pool of Major County, Oklahoma. The No. 63-3 Johnson showed for natural production from the Manning zone. Bottomed at 6920 ft, with 7-in. casing set at 6917 ft, and perforated at 6803-93 ft, the well flowed 32.25 bbl of oil in 2½ hr. Production was cut from 4 to 10 per cent with mud.



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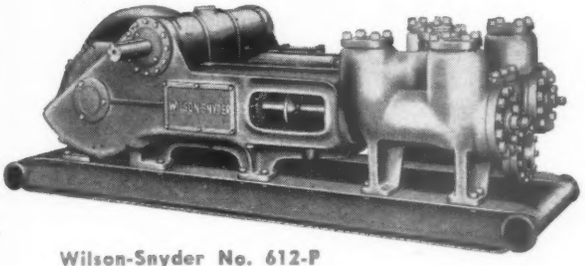

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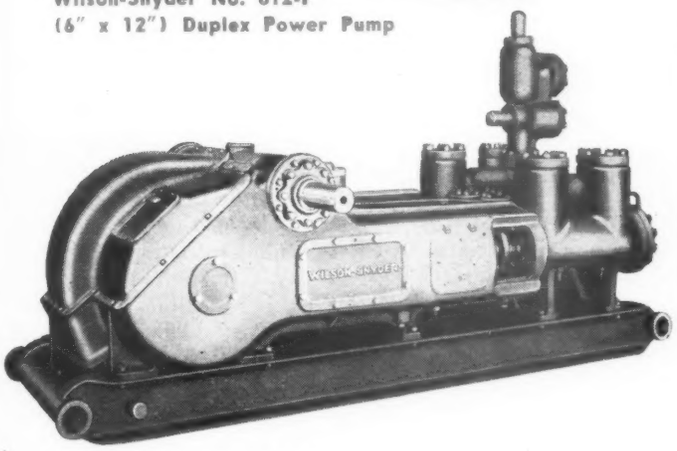
8P-HD	5" x 8"	3000	600	80	205	85
12P-LD	6" x12"	2000	365	70	395	100
612-P	6" x12"	3000	520	70	390	140
712-P	7¼"x12"	3000	550	70	580	220
14P-HD	7¼"x14"	4000	765	65	620	325



Wilson-Snyder No. 712-P
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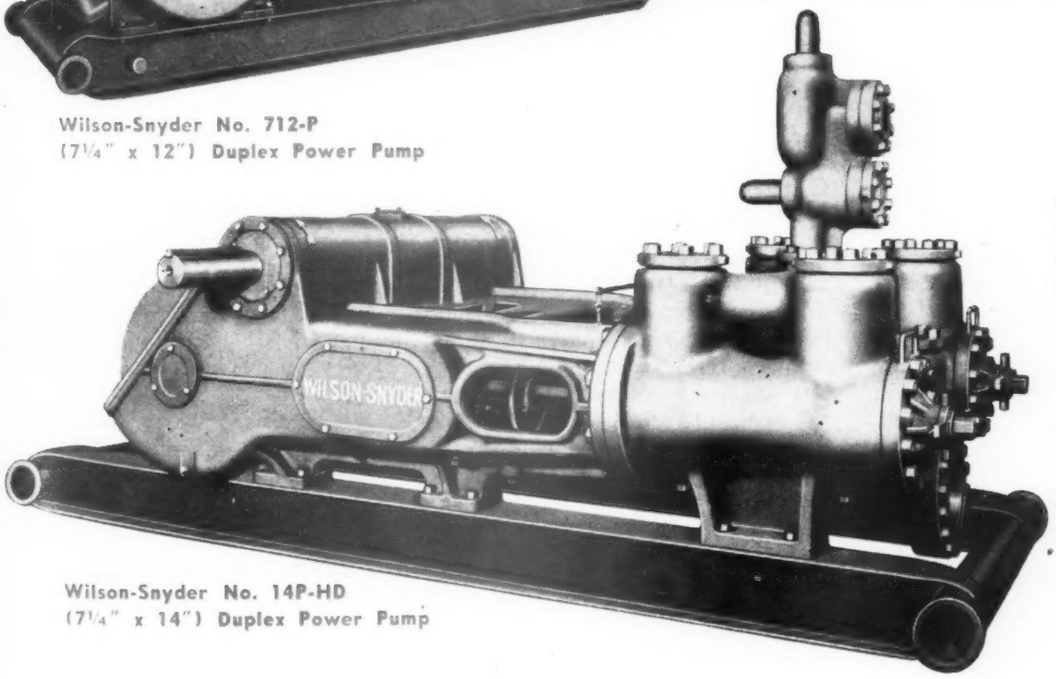

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EXPLORATION ACTIVITIES

Regional Exploration Meet to Be Held in Fort Worth

The Fort Worth Geophysical Society, Fort Worth Geological Society, and the Dallas, Ark-La-Tex, Tulsa, and Permian Basin Geophysical Societies will sponsor a regional exploration meeting to be held at the Texas Hotel in Fort Worth, Texas, Thursday and Friday, November 30 and December 1, 1950. There will be no charge for registration, which will commence Wednesday evening, November 29.

Immediately following the opening of the meeting on Thursday morning, an address will be made by an outstanding exploration executive. General theme of the meeting will be exploration problems of certain future oil provinces of the South Central United States. New and complementary papers covering the geology and geophysics and with emphasis on the exploration problems of the various provinces will be presented. In addition, there will be a few papers of general interest to geologists and geophysicists as well as a consideration of seismic velocity problems.

The TCU-SMU football game will be played in Dallas at 2:00 p.m. Saturday afternoon, December 2. Tickets to the game may be secured by writing to the director, athletic department, Texas Christian University, Fort Worth, or Southern Methodist University, Dallas. Requests to either of the above directors for football tickets should be accompanied by a check for $3.60 per ticket plus 35c to cover registry fee in mailing the tickets. In the event tickets are not available at the time of request, the check accompanying the request is returned. Requests for such tickets should be made immediately. Round-trip bus transportation from the Texas Hotel to the Cotton Bowl in Dallas will be provided at a rate of approximately $1 per passenger for those indicating their desire for such transportation at the time of registration.

James L. Morris, president of the Fort Worth Geophysical Society, and H. C. Vanderpool, president of Fort Worth Geological Survey, are general co-chairmen, and George H. Harrington, Jr., is chairman of the program committee. T. R. Shugart is president of the Dallas Geophysical Society, Richard Brewer, president of Ark-La-Tex; H. M. Thralls, president of Tulsa Geophysical Society, and Lorenz Shock, president of Permian Basin Geophysical Society.

Testing Continues At Indiana Well

The Louis Galambos No. 1 Anna B. Phillips is preparing to test the Mansfield sand at 1163 to 1169 ft in Gibson County, Indiana. Total depth is 1169 ft and the well was stopped in saturated sand. A two-hour drillstem test recovered 135 ft of oil cut mud and no water. The well is one mile from other wells.

Wyoming Discovery Seen

Signs of a gas oil discovery have been found in H. P. MacCauley and Day Dorough, Denver Independents' No. 1 Anderson in Cheyenne County, Wyoming. The well, situated 12 miles southwest of the Huntsman gas field, has been drilled to 5300 ft. On drillstem test it had an estimated 15,000,000 ft of gas a day. Casing was to be set on bottom and perforated in the "D" sand zone. Flow pressure increased from 400 to 750 lb in 30 min. while bottom hole pressure was 1225 lb after 15 min.

General Petroleum To Drill Utah Well

An exploratory well, the first in the San Rafael area of Utah, will be drilled immediately by the General Petroleum Corporation, it was announced recently at that company's Los Angeles headquarters.

The well location will be in Emery County, about 25 miles southwest of the town of Greenriver. In Salt Lake City, R. E. Landon, General Petroleum district geologist, and H. W. Chandler, district land agent, have been in charge of developing the exploration project.

Humble Well Marks New Area

Humble Oil and Refining Company is opening new production at its No. 1 well in the Timbalier Bay-Block 52 area of Terrebone Parish, Lousiana. On a 4-hr gage, the well flowed at the rate of 505 bbl daily through 7/32-in. choke from 12,111-114 ft. Tubing pressure was 2600 lb. Operator is continuing to test.

Well Tests 52 Bbl an Hour

General Petroleum Corporation's Government 84-32 in Slick Creek, Washakie County, Wyoming, tested 52 bbl per hour of 31.7 gravity oil. The sour crude, similar to that at Worland, 10 miles north, is coming from an 80-ft Embar phosphoria section between 10,464-544 ft, total depth. Gas recovery was 800,000 cu ft for 24 hours.

Second Well Discovered In Gulf of Mexico

Discovery of a second well in the Gulf of Mexico was announced recently by the Magnolia Petroleum Company, an affiliate of the Socony-Vacuum Oil Company, Inc., and the Continental-Newmont Oil Companies, joint developers of the well. The new well, designated No. A-3 by the developers, is on State Lease 693 and Eugene Island Block 125, about 25 miles off the coast of St. Marys Parish, Louisiana, and 65 mile south of Morgan City, Louisiana.

After perforations in a No. 3 Miocene sand at depths between 11,372 and 11,392 ft, the new well indicated a potential of 448 bbl per day of 36.6 gravity oil. The gas-oil ratio is about 860 to 1. Total depth of the well is 11,474 ft.

Gulf Coast Has New Pool

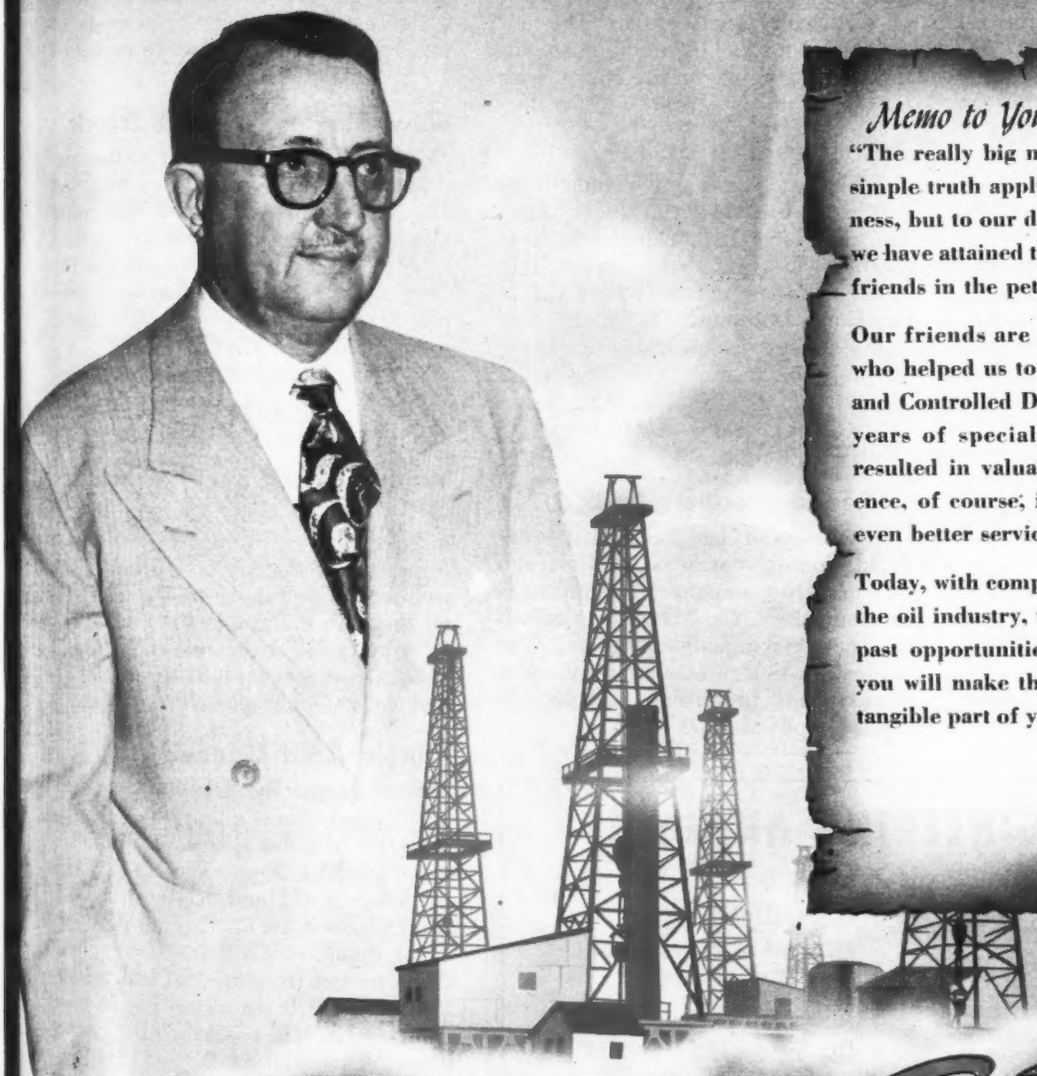
Floyd L. Karsten of Houston, Texas' No. 1 Sharp et al, is the discovery well for a new Brazoria County, Texas, field, 5 miles southeast of Arcola. The well is reported to have gauged 175 bbl of oil daily through an 1/8-in. choke from 7609 ft.

Discover Wilcox Production

C. N. Housh Drilling Company and American Republics Corporation have announced discovery of what is considered to be an important new Wilcox production in Colorado County, Texas, The No. 1 Pearle Wooten is situated approximately 5 miles southeast of production in the Columbus field, and 12 miles southwest of the New Ulm field of Austin County.

Casing, size 5½ in., was set to 8575 ft. One hundred sixty-eight perforations were made between 8512 and 8540 ft. Using a ¼-in. choke, and with tubing pressure of 1775 lb, the well produced 1,400,000 cu ft per day of gas and 33 bbl of 52 gravity distillate per 1,000,000 cu ft of gas.

Eastman's 20TH ANNIVERSARY



Memo to You! – Someone once said, "The really big man is a humble man." This simple truth applies not to our feeling of bigness, but to our deep gratitude for the growth we have attained through the help of our many friends in the petroleum industry.

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Navy Finds Two Wells On Alaskan Coast

After six years of exploration, the Navy has announced discovery of two minor oil fields in Alaska. One well is at Umiat, and is reported flowing at the rate of 500 bbl a day, producing high gravity oil. Productive capacity of the other field, situated at Cape Simpson, is unknown. Three more wells at Umiat are planned and all will be shallow—about 1000 ft deep.

New Texas Oil Pool Proved

Amerada Petroleum Company has opened a new basal permian, lime oil pool in southern Terry County, Texas, one mile north of the shallow Adair pool. The pool was opened with the completion of the company's No. 2 N. W. Willard. It flowed 912 bbl of 43 gravity oil through one-half inch tubing choke and through perforations in casing from 8500 to 8560 ft after acidizing with 500 gal. The producer is a wet offset to the firm's No. 1 Willard, which had indicated production in the pay while being drilled. No. 1 Willard is drilling below 12,215 ft to test the Ellenburger.

Increased Activity In Peru

Some interest is being shown in the Sechura Desert region of Northwestern Peru by several companies. This area adjoins the producing concession of International Petroleum Company, Ltd., and it has been declared a part of the national reserve. A new petroleum law to permit exploration of national reserve lands has been under study for some time.

Rank Wildcat Hit In New Mexico

A rank wildcat has been discovered in San Juan County, New Mexico, by Southern Union Producing Company, which hit Dakota Oil at its Navajo No. 1. Testing on pump is in progress with 160 bbl of oil and 50 bbl of water recovered in 24 hr.

Jack County, Texas Pool

Robert S. Lytle and associates of Los Angeles, California, and Warren Corporation 1 Riggs, has given a new Bend conglomerate oil pool and a gas pool to Jack County, Texas. The new well flowed 125 bbl of oil in 24 hr, through 16/64-in. tubing choke, with conglomerate pay from 5382-96 ft.

Tennessee Test at 3447 Ft

Whitney, Nance and Vivadelli are drilling below 3447 ft at their wildcat test, the No. 1 J. B. Donaldson, near Hornsby in Hardeman County, Tennessee. Present depth is reported in the Knox Dolomite. So far the hole has 4 strings of casing: 16-in. at 86 ft; 13⅜-in. at 632.1 ft; 10½-in. at 1002 ft, and 8⅝-in. at 2249 ft. Norris Madison of Glasgow, Kentucky, is doing the drilling.

Colorado Producer Drilled

A new pool has been opened in Weld County, northeastern Colorado by Shell Oil Company. Pool opener is the company's No. 1 Hanson, situated on the Buckingham structure. The wildcat, which was completed as a Muddy Sand producer was drilled to a total depth of 7250 ft.

Airlift Operations in Eastern Ecuador

Unusual exploration in Eastern Ecuador was notable for the airlift operations necessary to supply field parties and drilling wildcats with food and all equipment. Large airport runways were required at each wildcat, and geological and geophysical parties were supplied by parachute.

Geological and geophysical studies of the entire area, much of it in hostile Indian territory, were made from 1938 to March, 1950. Six wells were drilled, the last and deepest reaching a depth of 10,899 ft. Total costs of this venture are said to have exceeded U. S. $30,000,000.

New Mexico Wildcat Struck

Testing is still going on at the McAlester Fuel Company's No. 1-A Brownfield discovery well 15 miles north of the Denton field in Lea County, New Mexico. It had the Devonian at 11,790 ft, drilled to 12,035 ft and plugged back to 11,901 ft and set pipe. The wildcat flowed 416 bbl of oil in 18 hours through a ¼-in. choke. Casing was perforated at 11,785-840.

Wyoming Discovery Made

General Petroleum Corporation has discovered a Wyoming oil field two miles east of the city of Worland. The well was drilled down to 10,554 ft total depth in the Embar lime. It flowed 32 gravity oil at the rate of 1200 bbl daily. Observers said the discovery indicated a sizable oil field.

Illinois Area Opened

Sanders and Fye Drilling Company has opened a new oil producing area in Richland County, Illinois, about six miles south of Olney. The No. 1 Wells is cleaning out and testing the McClosky limestone at 3276 to 3282 ft. Total depth is 3282 ft. A one-hour drillstem test from the McClosky limestone at 3276 ft recovered gas in four minutes; 550 ft of clean oil and no water. This well is 2½ miles from other oil wells.

Sunray Reports Discovery

Sunray Oil Corporation has announced the discovery of a productive wildcat in Live Oak County, Texas. It is the J. C. Dillworth No. 1, four miles east of the town of Oakville. The new well produced at the rate of 2600 Mcf gas and 64 bbl of distillate on 14/64-in. choke on a potential test. Drilled to a total depth of 7656 ft, the well was perforated 7173 to 7214 ft. It is reported to have penetrated about 128 ft of gas distillate sand in the Wilcox formation.

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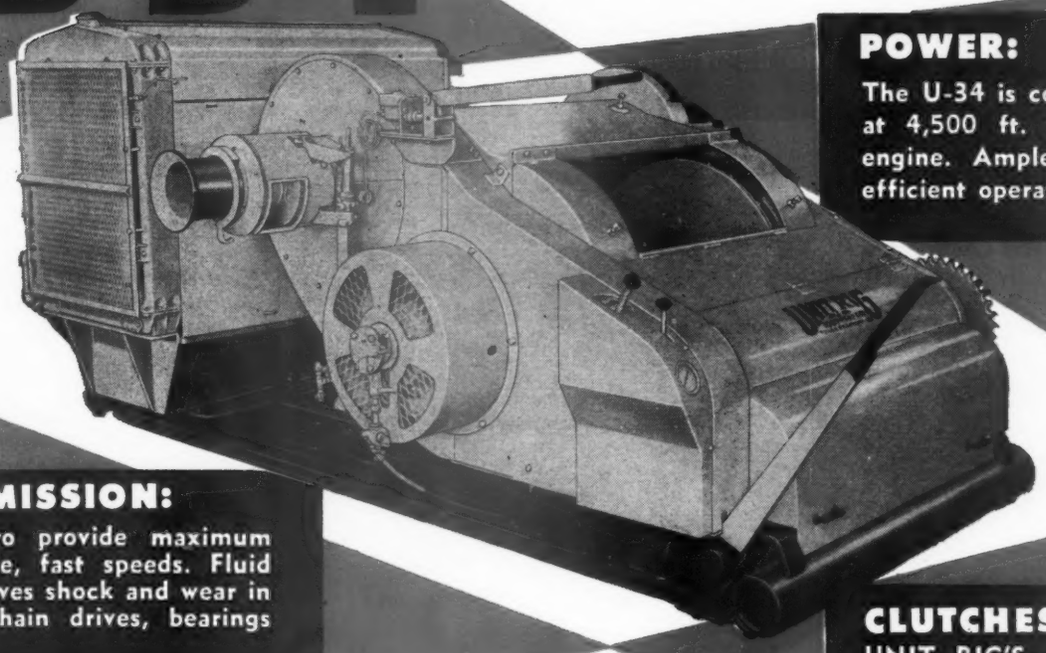
U-34

CUT COSTS on shallow well drilling. . .



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Running tour with men in the industry

▸ **Don O. Chapell,** vice president of exploration and land department, Sunray Oil Corporation, has resigned his position with Sunray, to become associated in land and geological work with Jake L. Hamon, prominent independent oil operator, First National Bank Building, Dallas, Texas.

George A. Schwab has been appointed manager of the Sunray land department and **E. A. Markley,** chief geologist, in the Mid-Continent area, it was announced by C. H. Wright, president of Sunray. These departments will operate under the direction of D. R. Snow, vice president, exploration and production.

Chapell joined Transwestern Oil Company in 1937 and has been associated with Sunray since the merger of Transwestern Oil Company into Sunray Oil Corporation in 1946. He was district geologist in San Antonio, Texas, and in 1948, was named vice president of exploration and land department.

▸ **R. B. Sale,** formerly assistant regional manager of Continental Oil Company's production department, Ponca City, Oklahoma has been promoted to the newly-created position of

R. B. Sale

director of training in the production department, with headquarters in Ponca City. Sale, who was born in Denison, Texas, received his early education at Shawnee, Oklahoma, and later attended Oklahoma A. & M. College, Stillwater. He joined Continental as a clerk in 1926.

Through various promotions Sale rose to the post of assistant region manager in 1949.

▸ **A. Rodger Denison,** chief geologist for Amerada Petroleum Corporation, Tulsa, Oklahoma was elected vice president. Other changes include: **John F. Hosterman,** named chief geologist, succeeding Denison; **John P. Thompson** and **Charles S. Agey,** named chief geologists. Denison, who joined Amerada in 1921 after graduation from the University of Oklahoma, was named chief geologist in 1937. Hosterman joined Amerada in 1922 becoming assistant chief geologist in 1943. He is a graduate of the Missouri School of Mines. A graduate of the University of Rochester, Agey joined the company in 1935, and became district geologist in 1946. Thompson joined Amerada in 1933 and became junior geologist in 1947.

Banquet room, Tulsa Country Club, showing Tulsa Nomads and guests at their Fall party, September 15. An adjoining dining room is not shown in picture, making a total of 180 attending. This was the beginning of their Fall and Winter activities. Carmine Grossi gave a brief talk on his experiences during 11 months in Western Europe.

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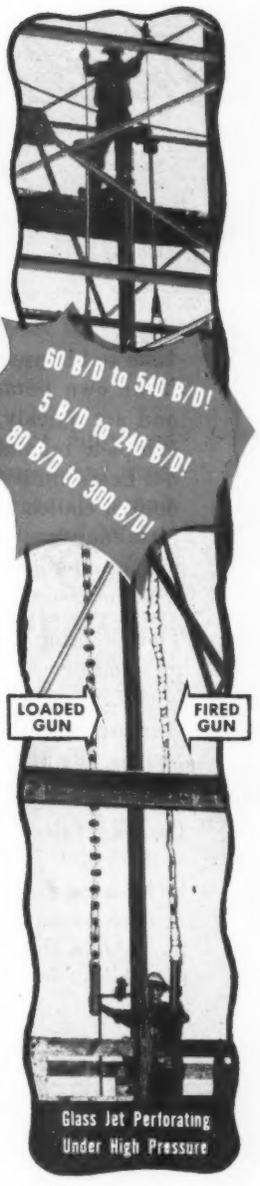

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▸ **John H. Bevel,** Gulf Oil Corporation, has been named general manager of Gulf's Canadian district. He has been zone agent at Calgary, Alberta, Canada for Gulf. Other changes are: **R. P. Lockwood,** named exploration manager; **P. L. Gassett,** made exploitation manager; **O. A. Erdman,** named chief geologist, and **R. W. Schweigert,** chief scout.

Lockwood, former zone geologist at Calgary was with Gulf for the past 17 years. Gassett, who joined Gulf 15 years ago, was formerly general production foreman at Edmonton. Erdman, previously a geologist in Canada, has been with Gulf for 4 years. Schweigert was formerly a scout at Evansville, Indiana covering the tri-state region for Gulf.

▸ **Larry Finfrock** has joined Sunray Oil Corporation as a geologist in the Jackson, Mississippi office. He was formerly geologist for Carter Oil Company in Jackson. Most of his 7 years with the company had been spent in the Mississippi area. Geological work by Sunray for the Mississippi area has been conducted from the Shreveport office. **Thurman Geddie,** district geologist for Sunray, has been transferred from Lake Charles, Louisiana to Houston, Texas in the same capacity.

▸ **Harry E. McDonald** has accepted a position as petroleum engineer in the oil valuation department of Mercantile National Bank at Dallas, Texas. Richard T. Bright is in charge of the department.

McDonald was graduated from Texas A & M in 1940 with a B.S. in petroleum engineering and from S.M.U. in 1950 with a degree of LL.B. in law. After graduating from Texas A & M, he spent two years in Venezuela as petroleum engineer for the Creole Petroleum Corporation, prior to joining the Army Air Corps. When discharged from the Air Corps, he was exploitation engineer for Shell Oil Company, Inc. for one year. More recently he has been a petroleum engineer in the reserve and valuation section of the petroleum engineering department of the Magnolia Petroleum Company.

▸ **John L. Ferguson,** formerly senior geologist in charge of geophysical interpretation for Amerada Petroleum Corporation, has been appointed head of Deep Rock Oil Corporation's land and exploration division. He fills the position vacated by the resignation of **W. G. Gish** in May. Ferguson received his A.B. degree from Dartmouth in 1915 and did graduate work at Harvard the following year. His work experience, however, began in the summer of 1914 when he joined a Canadian geological survey party in Nova Scotia as field assistant.

In 1928 he joined Amerada as district geologist at Amarillo, Texas, and had remained with that company in various geological capacities until his appointment at Deep Rock.

▸ **R. E. Minnis,** district geologist for Phillips Petroleum Company, at Shawnee, Oklahoma, has been transferred to Oklahoma City in the same capacity. **W. E. McNurty** was transferred from Shawnee to Oklahoma as assistant district geologist. Minnis succeeds **A. J. Montgomery,** who transferred to Bartlesville as division geologist. He was formerly district geologist in Oklahoma City for 16 years.

▸ **R. W. Biggart,** consulting geologist of Oklahoma City, Oklahoma, has joined Foundation Oil Company as exploration geologist. **Lloyd E. Worley,** vice president and manager of the land and geological department of Foundation has reported that henceforth the company plans to enter an increased exploration program. Biggart was formerly with British-American Oil Producing Company and Deep Rock Oil Company.

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J. H. Galloway, formerly district superintendent of the California district, Gulf Coast division, Humble Oil and Refining Company, has been promoted to assistant division superintendent, West Texas division. **John S. Bell,** who was division engineer of the East Texas division will succeed Galloway as superintendent of the California district.

Harry Pistole became division petroleum engineer of the East Texas division replacing Bell, and **Fred N. Wise** was promoted to assistant division petroleum engineer, Gulf Coast division, replacing Pistole.

W. W. Holland, toolpusher, was transferred from the Eucutta district, Lousiana division, to the Winters district, North Texas division.

M. H. Buchanan, district transportation foreman, Galveston Bay district, Gulf Coast division, was transferred to the Snyder district, West Texas division.

D. A. Howard, a vice president of Republic Natural Gas Company in Dallas, Texas for 5 years, has resigned to enter consultant work in Oklahoma City, Oklahoma. Prior to joining Republic Natural, Howard was with Cities Service Oil Company in Oklahoma for several years.

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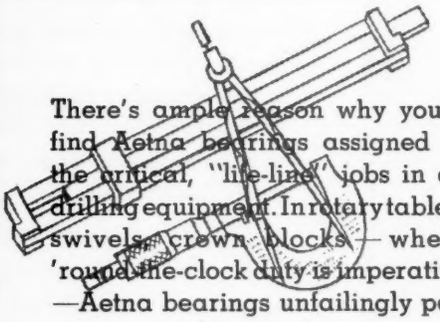

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Aetna BALL AND ROLLER BEARINGS

John Daly, former Honolulu Oil Corporation seismologist, has been named supervisor of the West Texas district for General Geophysical Company and will make his headquarters in Midland, Texas. Earle Johnson, president announced recently. Daly has been in charge of seismograph work in West Texas, New Mexico, Colorado, and Mississippi for Honolulu Oil Corporation. Daly began his career as geologist for 2 years with International Geophysics, Inc. He then joined Shell Oil Company in California for 9 years as a seismologist and geologist. In 1942 he joined Honolulu Oil Corporation and shortly thereafter moved to West Texas.

John Daly

Daly is a graduate of California Institute of Technology with a BS degree in science and a MS degree in geology and paleontology.

Hugh A. Tanner, geologist, recently joined Warren Oil Corporation in Midland, Texas. Before joining Warren, Tanner was employed with Ohio Oil Company and Hiawatha Oil and Gas Company in Midland.

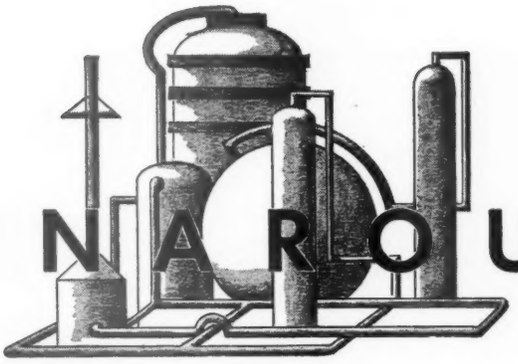
Al Wynn, geologist for Murphy Corporation, El Dorado, Arkansas, is being transferred to Calgary, Alberta, Canada, where he will be in charge of an office for the company. He will be succeeded by **Todd Landis, Jr.,** in El Dorado.

James L. Tatum, independent geologist, was recently elected president of the Four Corners Geological Society. Other officers are: **Joseph L. Borden,** district geologist for Pure Oil Company, vice president, and **Lee Graham,** geologist for Stanolind Oil and Gas Company, secretary-treasurer.

The Four Corners Geological society is an organization for the members of the American Association of Petroleum Geologists working in the four corners area of New Mexico, Colorado, Utah, and Arizona.

J. J. Schillinger, right of way agent for the General Petroleum Corporation, has been advanced to the post of assistant manager of the Right of Way Department. A veteran of 22 years service with General Petroleum, Schillinger joined the company as a messenger at the age of 17 and has worked for General Petroleum continuously since that time.

THE TURNAROUND



Propane-Fueled Planes

Adaptation of propane as fuel for planes has been accomplished on a "commercial" basis, according to information received from Hughes Carburetor Company of Oklahoma City. A high pressure vaporizer that does not require changes in the engine's carburetor, high pressure tank, and fuel lines has made the adaptation to airplane operation possible. The overall efficiency of propane fuel in planes is detracted from by the fact that the high vapor pressure of the fuel requires containers four to five times as strong, and presumably, four or five times as heavy as is required for conventional fuels of 7 to 10-lb vapor pressure. No data are available to indicate what percentage of the total plane weight is added by these heavier items. A gallon of propane, however, weighs about one pound less than a gallon of octane. With a fuel load of 100 gallons, therefore, the fuel system could weigh 100 lb more than that for regular fuel without adding to the total deadweight. Again, if advantage is taken of the 100 or higher octane rating of propane in the design of the engine or in its compression ratio it seems quite possible that the lighter weight of fuel per volume may be more than offset by the higher efficiency per pound or gallon. This is a development that may be watched with great interest and advantage to the automotive, the oil, and the transportation industry. Already butane and propane are employed in truck fleets, especially on the West Coast.

The "Octane-Less" Engine

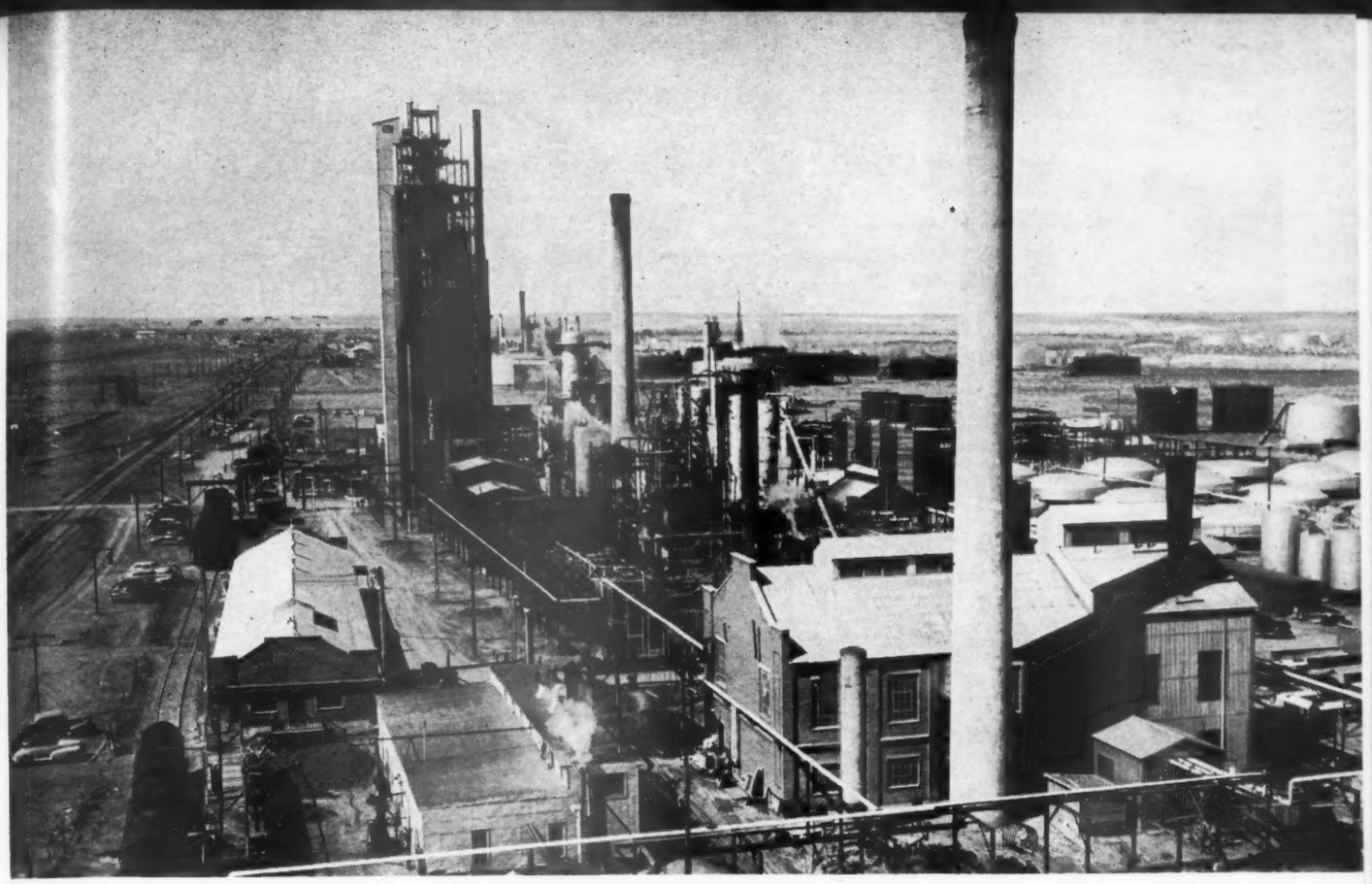
An engine developed by Texaco research scientists, which employs fuel injection, a la diesel practice, using light, carburetable fuels without regard to octane rating, bids fair to put the bee of engine efficiency squarely on the back of the automotive industry. Increased engine efficiency has followed the path of raising octane numbers, at refining costs that, for investment *and* operating as well, are rising to unbelievable heights. Among the numerous items of improvement in this experimental engine, developed and still under study at the Beacon, New York, Laboratories, are that fuels ranging from butane to gas oil may be burned with high efficiency and with virtually no knock. General adaptation of this principle—mechanical fuel injection—to automotive power plants in this country and elsewhere may revolutionize the methods of manufacture of motor fuels, heretofore 'tailormade' for carburetor handling. The conservation of petroleum and natural gas resources made possible, theoretically at least, by such a development is something to require the most sober thought on the part of the two industries' executives, economists, and technologists.

Bunker Fuel to Carbon Black

Latest development in Cosden Oil's expansion, and in Godfrey Cabot's search for carbon black sources has crystallized in Cabot interests building a plant near Big Spring, Texas, Cosden's refinery, to convert heavy fuel oil from the refinery's lowest priced product into carbon black. Recent advances in carbon manufacture and technology, the insatiable appetite of the rubber industry, especially synthetic rubber, for more and better rubber of the new types, makes this a most important move, first for Cabot and Cosden, last and always for the petroleum refining and the rubber industries.

Arch L. Foster

IN JUST
ONE YEAR!



Part of the cracking and distillation area with TCC unit in background.

P 741.

TCC Cracking of Rocky Mountain Crudes

The first TCC unit built for both vapor and liquid feed enables Socony to produce 53 per cent motor gasoline based on total run to refinery from a mixture of nine crudes, some sweet, some sour.

ARCH L. FOSTER*

CONVERTING a group of nine different Rocky Mountain crudes, some sweet, some sour, ranging in gravity from 14 to 48 API, into more than 50 per cent motor gasoline is the accomplishment of Socony-Vacuum Oil Company's White Eagle division refinery at Casper, Wyoming. The raw charge stock to this plant may contain portions of any or all crudes at any given time although the actual charge composition varies widely from time to time. Having installed a new Thermofor catalytic cracking unit a year ago and having operated it virtually continuously since that time, a few weeks ago a 14-day check run was carried out at the plant on which practically all useful engineering data were collected. It is around the typical and very indicative results of this check run that the article that follows is written. This TCC unit is the first one built to charge both vapor and liquid to the reactor.

*Refining-Gas Processing Editor.

Process Facilities

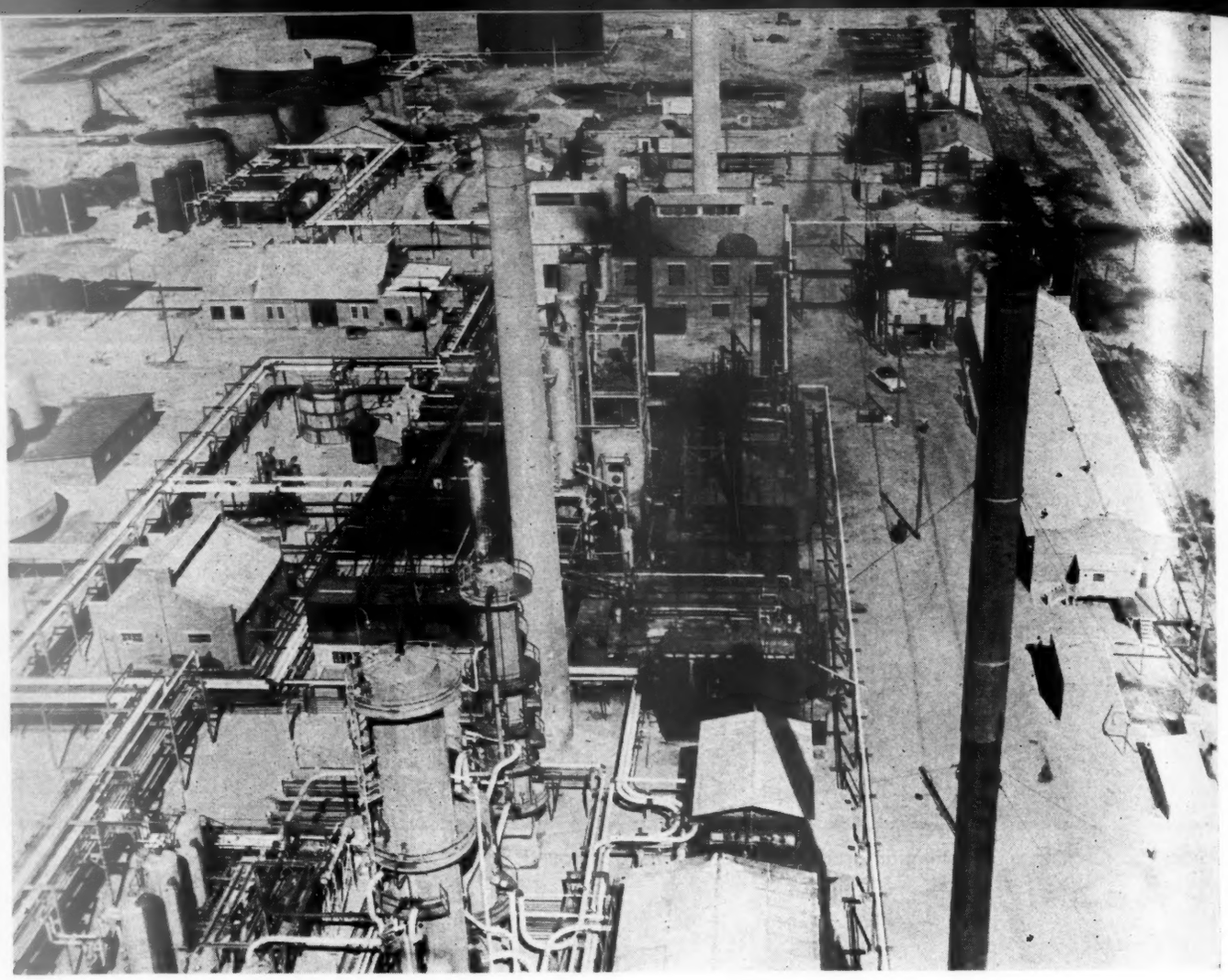
The essential operating units in the Casper plant include two parallel conventional atmospheric-vacuum units for primary and vacuum distillation of crudes; the TCC unit of 7500 bbl per day charge capacity referred to above built to charge both liquid and vapor stocks; a UOP catalytic polymerization unit, a vapor recovery unit, and the various typical auxiliaries. These units are so integrated and interconnected that they function to all purposes in the manner of a combination unit.

The check run carried out was essentially typical of ordinary operations, except that more exacting records of every phase of the run were kept, in order to determine the efficiency of each step of the operation of the entire plant.

Processing Routine

Of the various crudes processed, at least three, Cold Creek, South Cold Creek, and Big Muddy, are sweet crudes. Sour crudes include North Elk

EXCLUSIVE



Crude units at Casper from the TCC tower.

Basin and North Bighorn, with Neiber Dome as a light, high-sulfur crude producing 33 per cent gasoline of 300 end point.

The charge stock for the TCC unit came from the two primary crude stills, charging sweet and sour crudes respectively. In addition to the usual complements of straightrun naphtha and other products, these primary distillation units reduced to crude to 130-140 soft point asphalts, for which an expanding demand exists in the mountain country. Total gas oil charge to the cat cracker, therefore, is the sum of these streams from the atmospheric and vacuum units. Therefore, the combined streams for the cracker includes everything from light diesel oil to the heaviest oil obtainable from the charge stocks. This charge is transferred hot to the TCC unit (as vapor or liquid), with a small amount as surge balance, through a storage tank for processs coordination.

Both the virgin stock and the recycle stock are accumulated in a feed drum, from which it is pumped to and heated in a conventional pipe still, and is flashed in a tar separator, where vapor and liquid charge are separated.

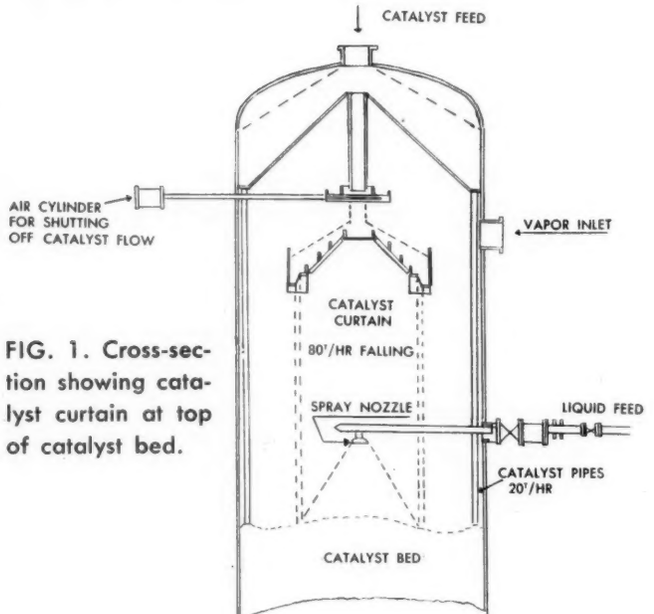


FIG. 1. Cross-section showing catalyst curtain at top of catalyst bed.

The overhead vapors from this tar separator are heated to 890 to 950 F, and discharged into the reactor. The unvaporized liquid from the tar separator bottom goes to the reactor as liquid oil at around 700 F, and is sprayed over the catalyst bed inside a falling catalyst curtain, thus controlling the contact areas of liquid at the top of the catalyst bed (See Fig. 1). This catalyst enters the reactor from the regenerator at about 990 F, and maintains an average temperature of approximately 875 F in the reactor.

In the check run under discussion the ratio of recycle to fresh feed was

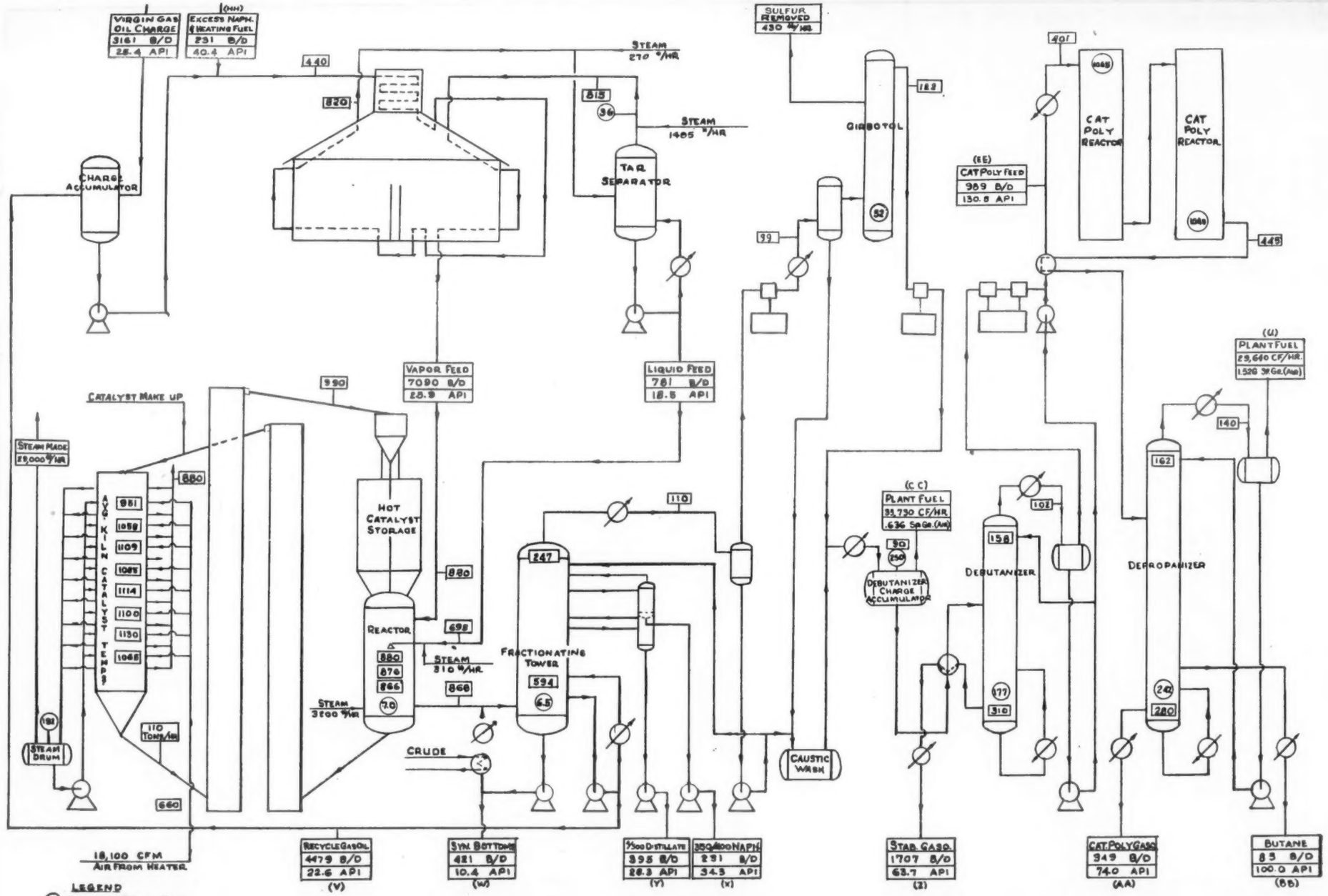


FIG. 2. TCC, GAS PLANT AND CAT POLY UNITS

maintained at 1.32 to 1; the catalyst-oil ratio was held at 2.90 to 1 and the reactor top pressure was held at about 9.5 lb. The liquid feed to the reactor constituted about 10 per cent of the total charge, the remainder being, of course, vapors from the separator. Other primary conditions in the operation are shown in Table 3. Also, the manner of introducing the vapors and the liquid feed streams into the reactor is shown in Fig. 2.

After the cracking reaction is completed the handling of the effluent follows conventional routines. Propylenes and butenes from the overhead vapors from the debutanizer are polymerized in the UOP catalytic unit to produce about 350 bbl per day of 74 gravity polymer gasoline, which with the catalytic gasoline, makes a blend of 90-91 Research octane number clear. As the TCC gasoline rates 89-90 octane number, the polymer product shows a somewhat higher rating to pull up the blend by one or more numbers.

Table 1 shows the typical yields of the various products. Debutanized TCC gasoline amounts to just less than 2000 bbl per day, or 57.5 volume per cent of the fresh charge; synthetic bottoms of about 10 API gravity or slightly higher, amounts to 12.4 volume per cent, with the remainder divided between butanes, 16 per cent, cracked distillate nearly 12 per cent, for a total "Butanes and Heavier" yield of 97.5 per cent; the remainder of the charge going to propane and lighter and carbon. By combining the polymer products with the catalytic fractions the total "C_4 and Heavier" yield becomes 99.6 volume per cent of the total charge, and the 10.5# R.V.P. 400 F gasoline is 68.72 per cent of the fresh charge.

Table 2 shows the composition and some characteristics of the liquid-stream charge. Liquid feed is 781 bbl per day, or 10,737 lb per hr, 23.2 volume per cent of fresh feed. With 18.5 API gravity, sulfur of 1.61 per cent and Conradson Carbon Number of 2.94 this liquid is fairly heavy, but

TABLE 1

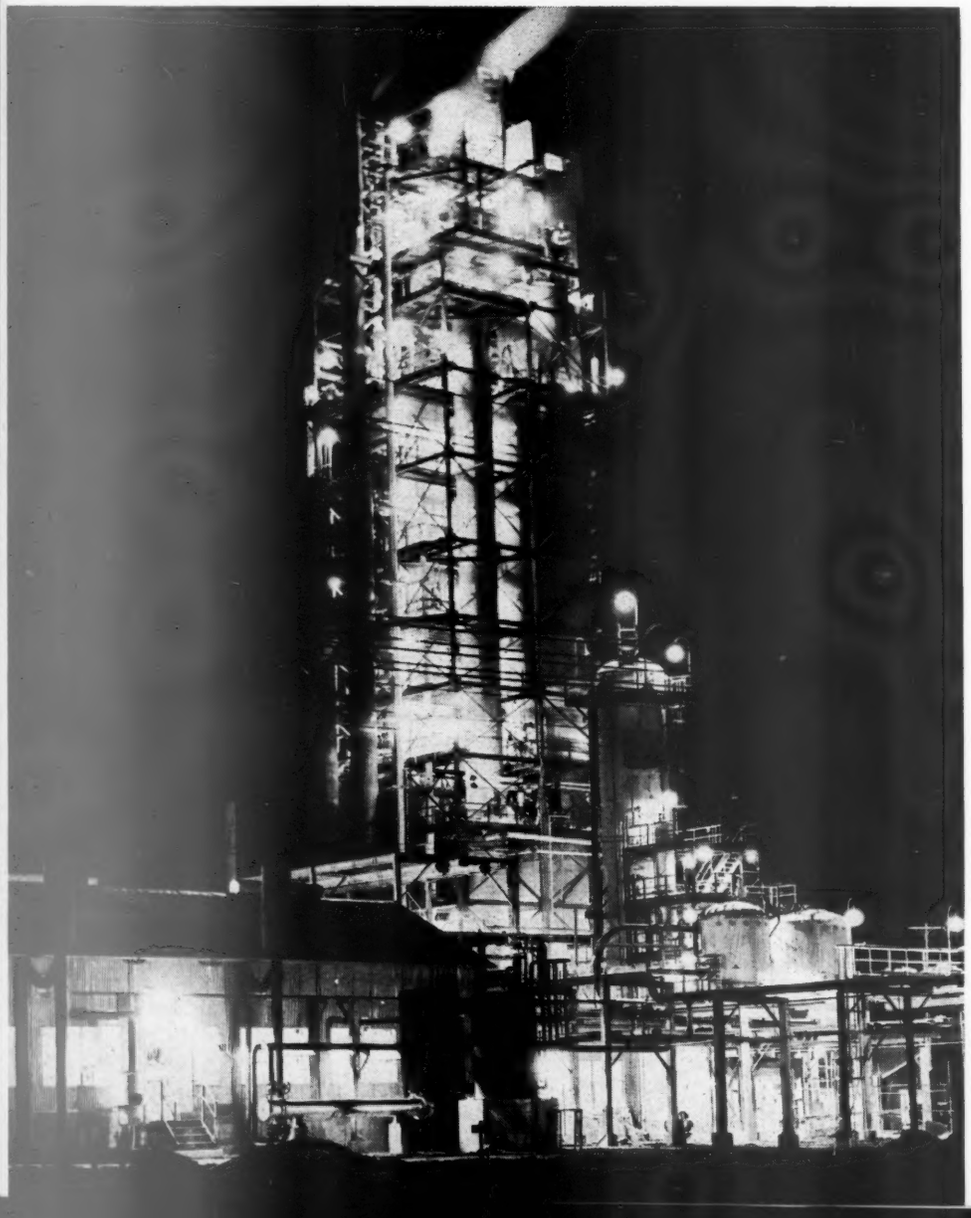
	BPD	Volume % Fresh feed	Pounds Per hour	Wt. % Fresh feed
T.C.C. COMPONENT YIELDS				
Debutanizer 400 E.P. gasoline	1,947	57.5	20,825	47.0
Butanes	547	16.1	4,662	10.5
400-500 cracked distillate	395	11.6	5,115	11.5
Snythetic bottoms	421	12.4	6,115	13.9
C_4 and heavier liquid recovery	3,310	97.6	-	-
Propane and lighter	-	-	4,261	9.6
Carbon	-	-	3,336	7.5
Total			44,314	100.0
Total yields including catalytic polymerization.				
10.5# RVP 400 EP gasoline	2,331	68.72	24,840	56.06
Excess butanes	232	6.83	1,920	4.33
400-500 cracked distillate	395	11.64	5,115	11.54
Synthetic bottoms	421	12.41	6,115	13.80
C_4 and heavier liquid recovery	3,379	99.60	-	-
Propane and lighter	-	-	2,988	6.74
Carbon	-	-	3,336	7.53
Total			44,314	100.00

TABLE 2. Liquid charge to TCC reactor.

Liquid charge, B/D	781
Liquid charge, #/hr	10,737
Volume per cent based on:	
Fresh feed to unit	23.2
Total feed to reactor	9.9
Laboratory Inspection:	
°API	18.5
Vacuum Engler Distillation*	
IBP	440°F
10	605°F
20	690°F
30	765°F
40	827°F
50	871°F
60	Cracking
Aniline Number	178.5
Sulfur, wt. %	1.61
Conradson carbon	2.94

* 760 mm

TCC unit at night.



appears to show good yield in the operation although yield on the liquid alone cannot be segregated in this operation.

For those readers who may be interested in making calculations on the operation from the chemical engineering viewpoint, Table 4 is included here. The data here show the amounts by weight of the different streams from the two parallel crude units through the vapor recovery system as well as the percentages and the yields of finished fractions obtained. These data are augmented by the charge and operational details shown on the flow-chart, Fig. 2. This gives a comprehensive view of the entire operation and its results.

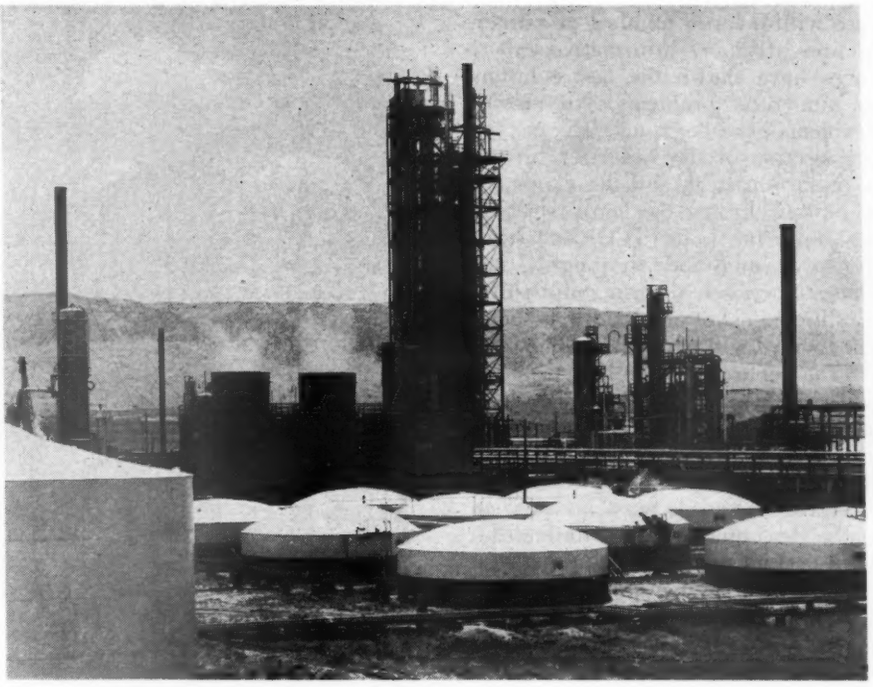
Of considerable interest also, to the chemical engineering student of cracking operations are the data given in Table 5, showing the composition of the effluent from the TCC reactor. Notable in these values are the yields of C_5s, pentanes and pentenes, which make up 16.54 per cent of the total "350 F and lighter" product, of which nearly 10 per cent is isopentanes. Similarly, 50.24 per cent of this 350 and lighter stream is found to be hexanes plus, up to 350 F end-point. Propylene and the three butenes compose 12 per cent of the 350 and lighter product; isobutane alone is 8 per cent of this fraction, all figures of major interest from either the motor or aviation fuel blending angle, or for consideration as alkylation unit charge stocks.

Obviously the interesting facts in this story are those showing the overall results obtained from this first year of operation of this unit, the first unit of the TCC process to be designed to allow the introduction into the reactor of liquid feed. By comparison with data from other sources on purely vapor charge operation, the advantages, not only in gasoline and polymer product yields may be seen, but in the yields of other products, especially distillate fuel oils.

In dealing with a combination of sweet and sour crudes, as may be the

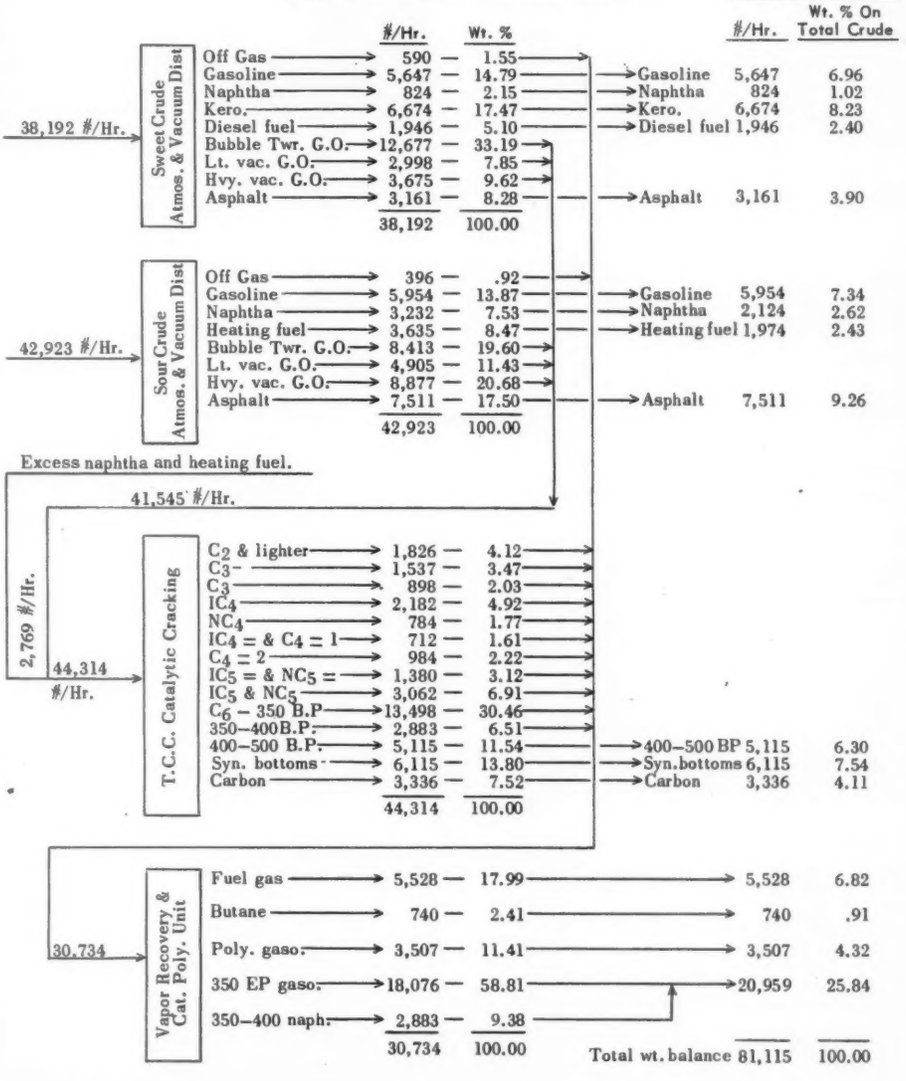
TABLE 3. TCC operating conditions 6-15-50.

Space vel., total feed	1.62
Catalyst/oil ratio, vol. % (total charge).	2.90
Catalyst to reactor, °F.	990
Avg. catalyst temperature in reactor, °F	875
Vapor feed to reactor, °F.	890
Liquid feed to reactor, °F	698
Catalyst activity	29.9
Recycle ratio by volume	1.32 to 1
Gravity of fresh feed, API	27.8
Vol. % liq. feed in total reactor charge	9.9
Vol. % liq. feed based on fresh feed	23.2
Steam, wt. % total feed	2.2
Reactor top pressure, PSIG	9.5
Catalyst circ., T/hr	110
Carbon on spent catalyst, wt. %	1.90
Carbon on reg. catalyst, wt. %	.47
Kiln steam prod., #/hr (net)	29,000
# sulfur removed in girbotol, #/hr	430



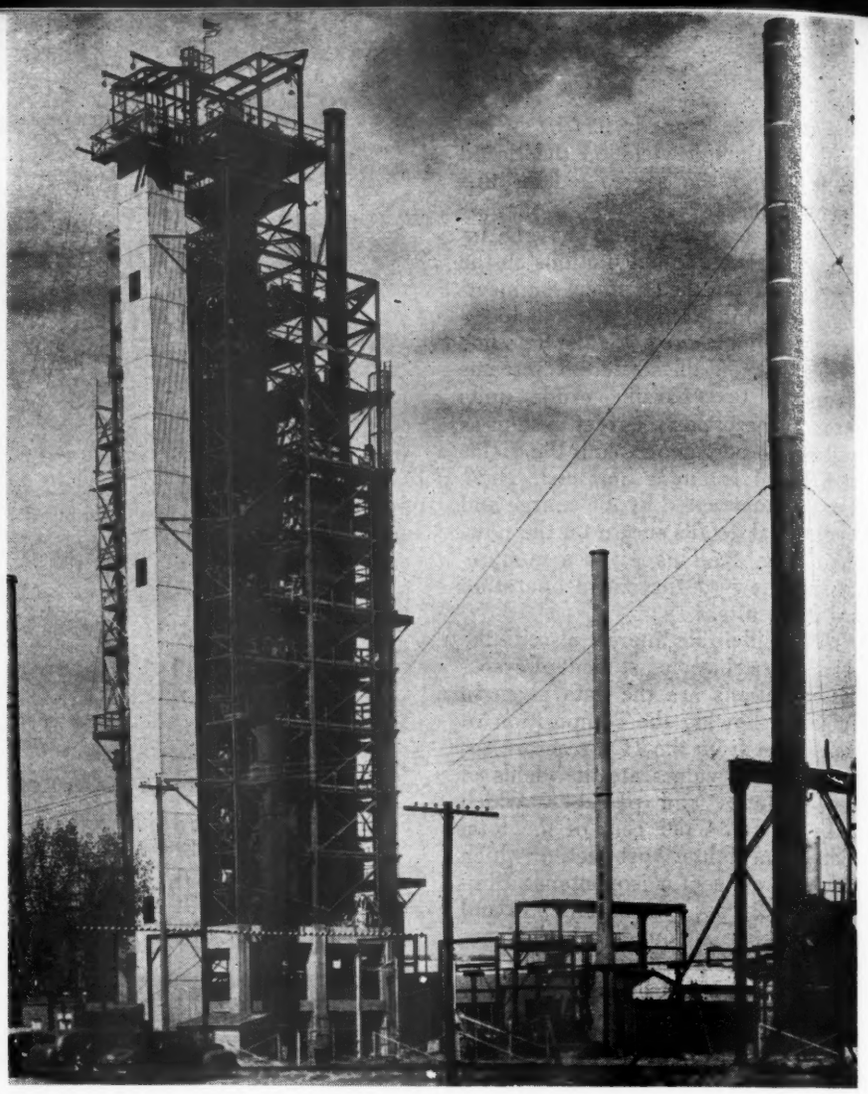
Socony refinery shows up against Casper Mountain Range.

TABLE 4. Weight material balance.



case with a large number of refiners at present, many informative experiences have shown the best solutions to numerous problems. No erosion problems have been met. The convection section of the vaporizer furnace is of carbon steel, and the vapor coil is of 4-6 chrome, ½ moly steel. In designing the unit (TCC) the situation was analyzed thoroughly and materials chosen to meet mild sulfur conditions. The catalytic reactor is lined with 12-14 per cent chrome steel, the tar separator feed line is 5 per cent chrome. The 'Synthetic Tower' is lined with 12-14 chrome to the level therein, which runs at 550 F temperature, including about the first two or three trays. Vessels must be lined up to the dewpoint level to eliminate or minimize sulfur corrosion.

The ability to handle liquid phase feed stock in TCC unit depends solely upon the amount of heat supplied. In order to separate the reactor effluent from the catalyst, the effluent must be entirely vaporized. It follows, therefore, that the catalyst must be sufficient to vaporize any liquid phase feed and retain a sufficiently high catalyst temperature to accomplish the desired cracking. The optimum condition is attained when the maximum possible amount of the feed is vaporized and introduced as a superheated vapor.



Close up of TCC unit.

TABLE 5. Composition of TCC reactor effluent.

	Analysis of Reactor Effluent			
	Total effluent		350 B.P. & lighter ratioed to 100%	Composition of 350 & lighter calc. from end products
	Vol. %	Wt. %	Wt. %	Wt. %
Hydrogen sulfide	.35	.54	2.09	1.64
Other acid & fixed gases	.85	.16	.66	.35
Methane	1.89	.57	2.21	2.14
Ethene	.40	.20	.78	.81
Ethane	1.11	.51	1.97	1.85
Total	1.51	.71	2.75	2.66
Propene	2.21	1.40	5.41	5.73
Propane	1.72	1.07	4.14	3.34
Total	3.93	2.47	9.55	9.07
Iso-butane	2.84	1.95	7.54	8.13
Iso-butene and butene - 1	.76	.55	2.13	2.65
Normal butane	1.46	1.04	4.02	2.92
Butene - 2	1.33	1.00	3.87	3.66
Total	6.39	4.54	17.56	17.36
Iso-pentane	2.64	2.01	7.78	9.85
Iso-pentene	.80	.63	2.44	1.92
Normal pentane	.48	.37	1.43	1.56
Normal pentene	.72	.57	2.21	3.21
Total	4.64	3.58	13.86	16.54
Hexane plus - 200	5.63	4.81	18.59	50.24
200 - 250	2.93	2.71	10.47	
250 - 300	2.86	2.80	10.82	
300 - 350	2.94	2.96	11.44	
Total	14.36	13.28	51.32	50.24
350 - 400	3.23	3.34		
400 - 450	3.34	3.55		
450 - 500	10.50	11.52		
500 - 515	4.41	4.97		
515 - 701	37.62	42.22		
Residue	6.98	8.55		
	66.08	74.15		
TOTAL	100.00	100.00	100.00	100.00
Quantity #/hr		100,767	26,059	26,865

The remaining quantity of heat required to vaporize any liquid phase feed is supplied by the hot catalyst entering the reactor.

The rate of catalyst attrition, and loss of catalyst as fines is not quite high enough to maintain the catalyst at an activity rating of 30, the standard rating adopted. It is necessary, therefore, to add more catalyst than is lost in fines and so discard a small portion of the used catalyst to maintain activity. Catalyst circulation is about 115 tons per hour. Regenerator air is supplied by a single-stage 385 hp Ingersoll-Rand centrifugal blower driven by an Elliott steam turbine. An effort is made to hold down the catalyst-oil ratio to about that indicated above, as too high ratio means formation of too much gas and carbon with resulting poorer yields of useful products. In a gas lift type of unit for handling catalyst, practically any amount of catalyst may be circulated. In this unit the maximum rate of circulation is limited by the capacity of the conveyor lifts installed. Catalyst employed is the new synthetic bead type containing a small amount of chromic oxide, Cr_2O_3. * * *

EXCLUSIVE

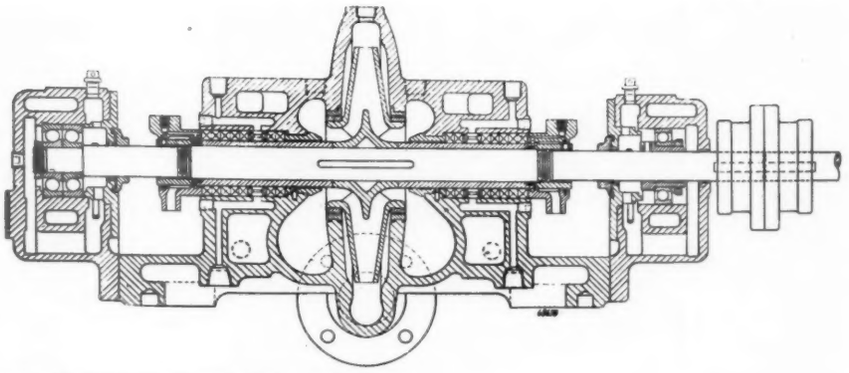
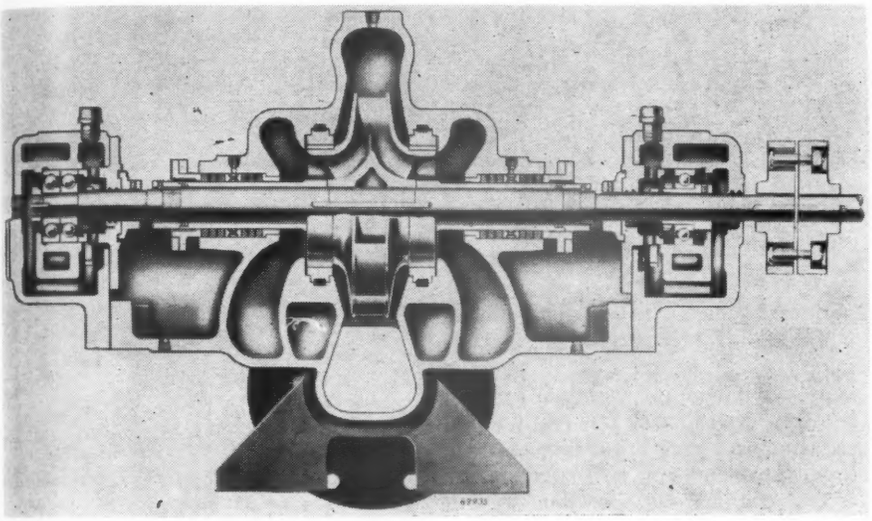


FIG. 2. Double suction pump, water-cooled stuffing boxes

FIG. 1. General purpose double-suction pump.



Keep Your Pumps on Stream

Maintenance depends on suitable materials —adequate lubrication is also prime factor.

L. J. DAWSON*

KEEPING centrifugal refinery pumps on stream is a matter of vital importance to all refinery personnel. Pumps are literally the "heart" of the refinery. "Heart failure" means down-time, and down-time costs money. For this reason, all refinery personnel can profit by a better understanding of pump construction and maintenance.

Although the basic hydraulic principle is the same for all centrifugal pumps, the mechanical details are varied by the designer in order to produce a pump best suited for the conditions under which it must operate. A few basic types will be illustrated and described briefly.

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Fig. 1 shows a horizontally split double suction general purpose unit. The impeller is placed between bearings that are ring-oiled and water cooled. Shaft sleeves are provided under the packing, and the impeller and casing have renewable wearing rings. This type of unit is generally furnished with bronze impeller and cast iron casing and operating temperature is limited to about 250 F.

For higher temperatures where a steel casing is required, and where water-cooled extra-deep stuffing boxes are in order, a design as shown in Fig. 2 is offered. Smothering-type glands to quench stuffing box vapors are standard. Pumps of this type are in successful operation up to 800 F. A two-stage design is available for greater heads.

The overhung impeller design shown in Fig. 3 is popular for smaller capacities, for any temperature. As there is only one stuffing box, it is especially adapted to handling low specific gravity, high vapor pressure fractions, and for this type of service, a mechanical seal often replaces conventional packing. The pumping element and bearing assembly may be removed without disturbing the suction and discharge piping. A large water-cooled oil reservoir is conducive to long bearing life. The same general design is used for slurry service but modified to include open-type impeller, renewable suction shroud, end-wise shaft adjustment, and provision for clean oil injection at the bottom of the stuffing box. Fig. 4 shows a typical slurry design.

For higher pressures, more stages are needed. The design shown in Fig. 5 is available in 4, 6, and 8 stages and may be cast in steel as well as iron. For a greater number of stages a vertical design such as Fig. 6 is available. Shaft deflection ceases to be a factor, and any reasonable number of stages can be used.

The proper selection of correct mechanical design to fit the application is the first step towards low maintenance. The next factor is the correct selection of materials. Here we are bound to run into economic considerations. In many cases of handling aggressively corrosive liquids, it is possible to build the pump of completely corrosion resistant materials, which naturally are expensive compared to bronze, cast iron, and straight carbon steel. The engineer making the pump selection is faced with the problem of compromising between reasonable service life and reasonable cost.

For neutral liquids, moderate temperatures and pressures, a "regular fitted" pump is the usual selection. "Regular fitted" pumps have a cast iron casing, bronze impeller and impeller rings, and cast iron casing rings. For highly alkaline liquids (high pH)

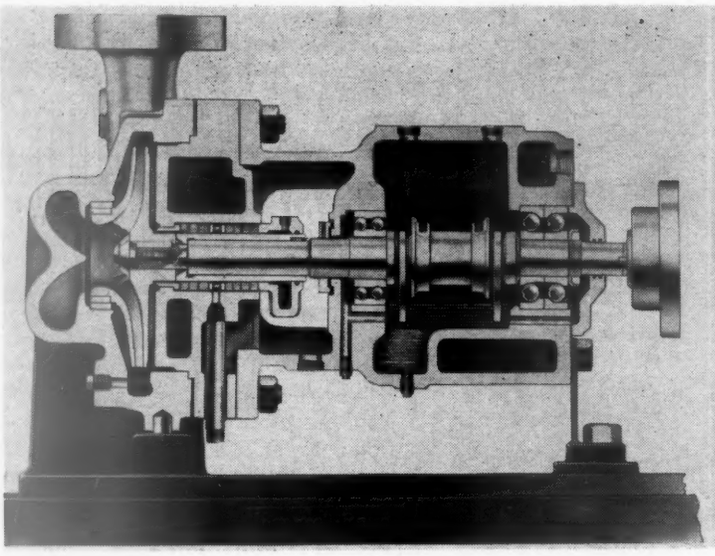


FIG. 3. Vertically split, overhung design process pump.

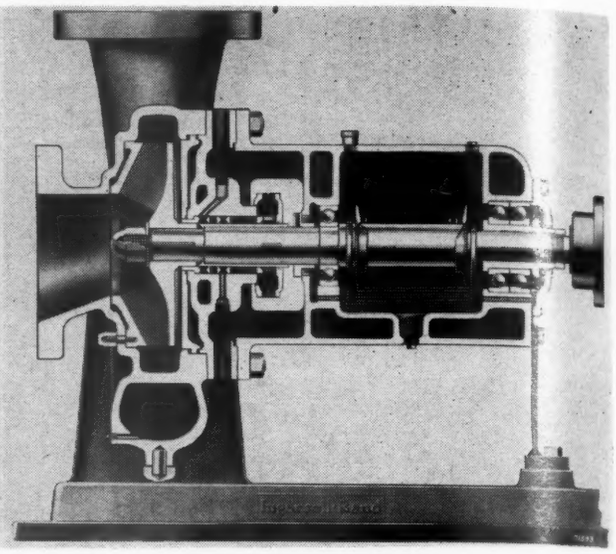


FIG. 4. Slurry pump.

the bronze parts are replaced with iron, and an "all iron pump" results. Likewise, for moderately acid (low pH) liquids, the iron parts are replaced with bronze and an "all bronze" pump results. "All bronze" is also the correct selection for most brines and for sea water. When handling any liquid that is a good electrolyte, dissimilar metals must be avoided unless their position on the electromotive series is close enough to minimize battery action.

For higher temperatures and for volatile liquids where definite fire hazard exists, a steel pump is indicated. For non-corrosive service, such as refined products, a straight carbon steel is satisfactory and cost is minimum. For sour and corrosive oils, some form of alloyed steel must be selected, the amount of alloy depending on the degree of corrosiveness of the liquid. Popular alloys are 4-6 per cent chrome ½ per cent moly; 11-13 per cent chrome; 18 per cent chrome 8 per cent nickel; or 18 per cent chrome, 8 per cent nickel with 3 per cent moly.

Stuffing boxes are a necessary nuisance. Fortunately for the operators and maintenance men, good stuffing box design is offered by all high-grade pump manufacturers; and packing suppliers have improved their product so that there are very few really tough packing problems left. Most of these tough problems can be solved by use of a mechanical seal, of which we will hear more later.

Going back to packed boxes, the simplest arrangement is a solid packed box, which is suitable for clean liquids at moderate temperatures and gravities of .6 and over with positive pressure on the box. For vacuum operation, or for pumps under lift, a seal cage with water or oil injection should be used. Injection of oil, grease or Merco lubricant should be provided for light gravity hydrocarbons that have poor lubricating qualities. For high temperatures where cooling effect is desirable in addition to lubrication of the packing, a circulating type box where sealing liquid circulates through the seal cage is required.

Shaft sleeve material selection goes hand in hand with stuffing box design. For ordinary cold liquid service at low pressures, a bronze sleeve will give

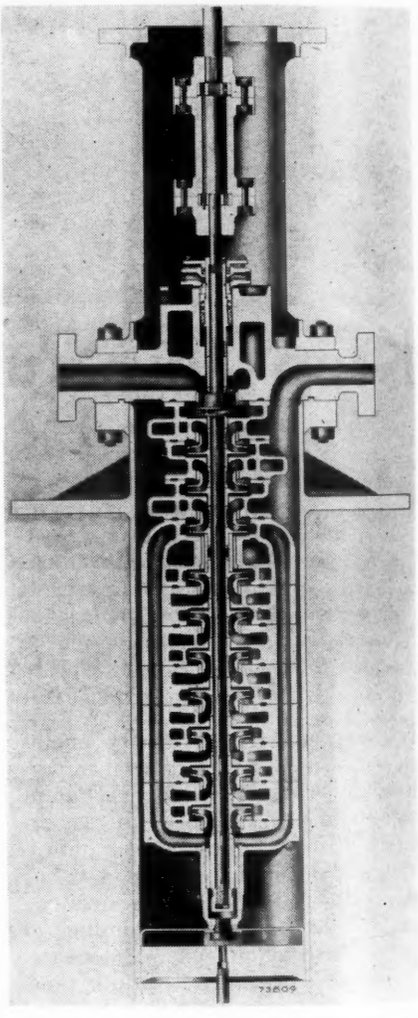


FIG. 6. Above, multi-stage vertical pump.

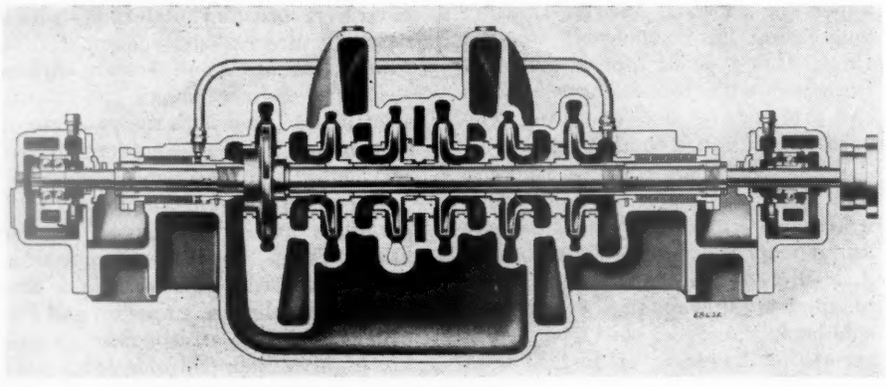
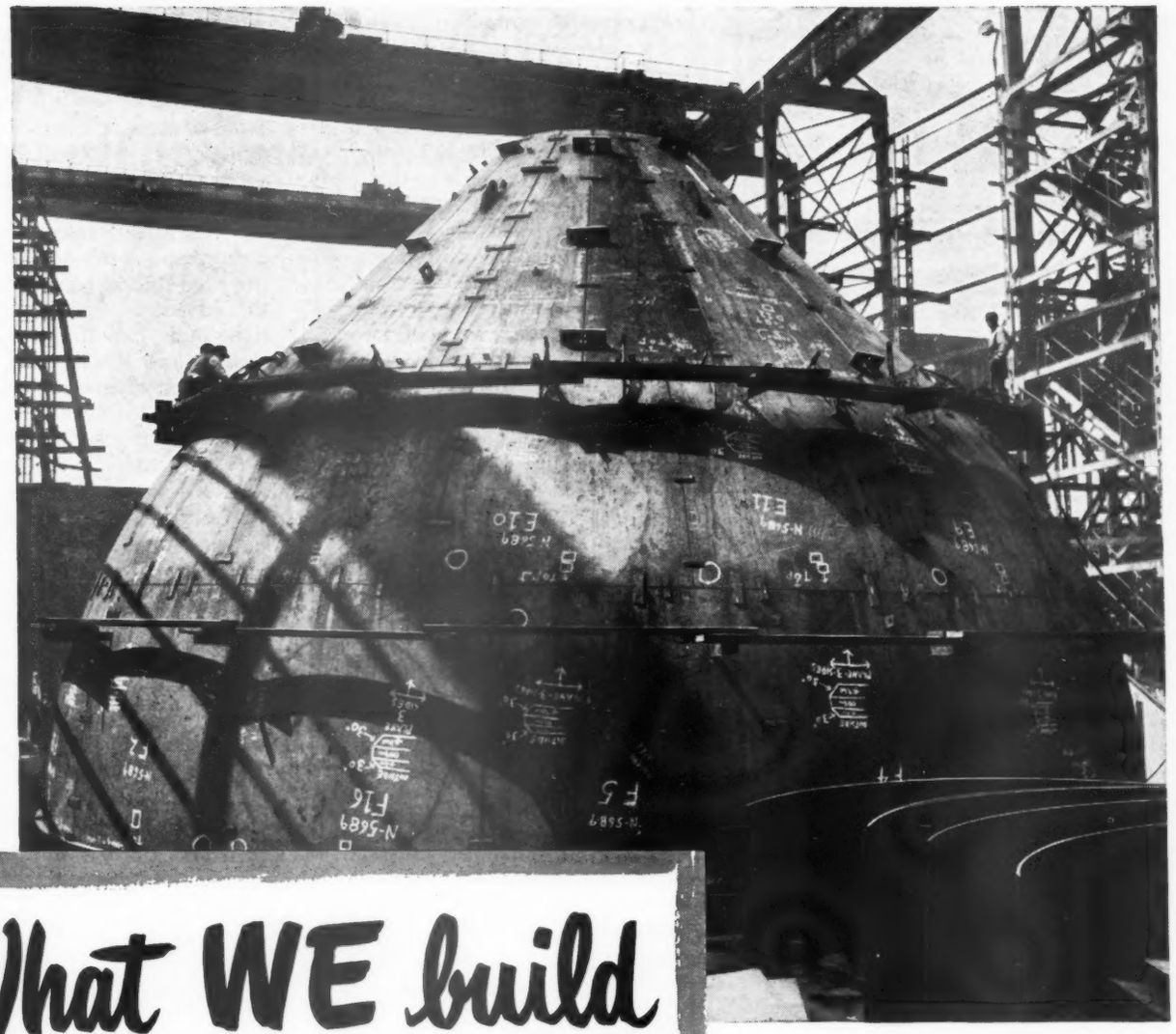


FIG. 5. Left, multi-stage horizontal pump.



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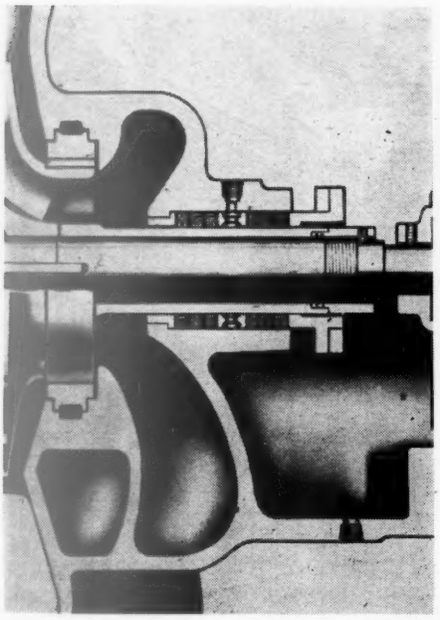


FIG. 7. Standard gland.

satisfactory service at low initial cost. If metallic packing is to be used, a hard sleeve is required. Carburized steels have a surface hardness of 600 Brinnell and a depth of case of about $\frac{1}{32}$-in. For a harder surface, Nitralloy is available, but case depth is only 1/64 in. However, Nitralloy has the added advantage of retaining hardness at temperatures up to 1000 F, whereas case-hardened steel and hardened stainless steels will begin to draw at above 600 F.

For corrosive conditions, a hardened stainless steel or a Stellited sleeve is required. A popular stainless is 18 per cent Cr. 5 per cent Ni with sub-zero precipitation hardening to 425 Brinnell. Hardness is uniform throughout the thickness of the sleeve so that wear does not change the hardness of the surface. Stainless steel sleeves are subject to "concentration cell corrosion" and "differential aeration" attack when stationary for long periods of time while in contact with woven packings.

Stellite as a hard-facing for shaft sleeves provides a hard, tough corrosion-resistant and heat-resistant surface and is useful in difficult packing jobs. Stellite is not justified for easy jobs due to the high initial expense of Stellited sleeves.

Stuffing box gland design varies with the job to be done. For cold liquids, non-explosive and non-toxic, a standard gland (Fig. 7) may be used. For volatile or toxic fluids, or for water above 180 F, a smothering gland with quench water is indicated (Fig. 8). A new modification of the quench-type gland is the patented "Leakollector" gland shown in Fig. 9, which is available on certain chemical-type pumps. An outer rim slides on a machined fit on the outside diameter of the stuffing box thus collecting any leakage around the outside of the packing rings as well as leakage between the packing and shaft sleeve.

For certain classes of difficult stuffing box conditions, a mechanical seal is the logical solution. Perhaps the greatest application of seals is for light gravity hydrocarbons such as propane, butane, propane-butane or propane-ethane mixtures. Conventional stuffing box packing is handicapped in handling these liquids for two reasons; first, the liquids are devoid of any lubricating value, and second, the natural vapor pressures are high causing high stuffing box pressures. Before the advent of seals, pumps handling light ends had to be equipped with elaborate seal oil systems to effect lubrication of the packing. In addition, there was always the danger of a blown packing box causing a fire.

A mechanical seal is superior to standard packing on certain classes of intermittent service where a short run is followed by a long standby period. This is particularly true on loading service where quick closing valves usually produce a hydraulic shock just prior to shut-down. A shock wave of this type will disturb the setting of a packed box, with the result that the box will leak heavily after the unit is shut down. If the packing is adjusted after the unit is down, it will be too tight when the pump is restarted. Mechanical seals are not affected by the usual shock wave and remain bottle tight when running or standing by.

The basic elements of a single seal are shown in Fig. 10. Sealing is effected between the precision-lapped faces of the rotating and stationary seal rings. The stationary seal ring is usually carbon, and is mounted in the

FIG. 8. Smothering gland.

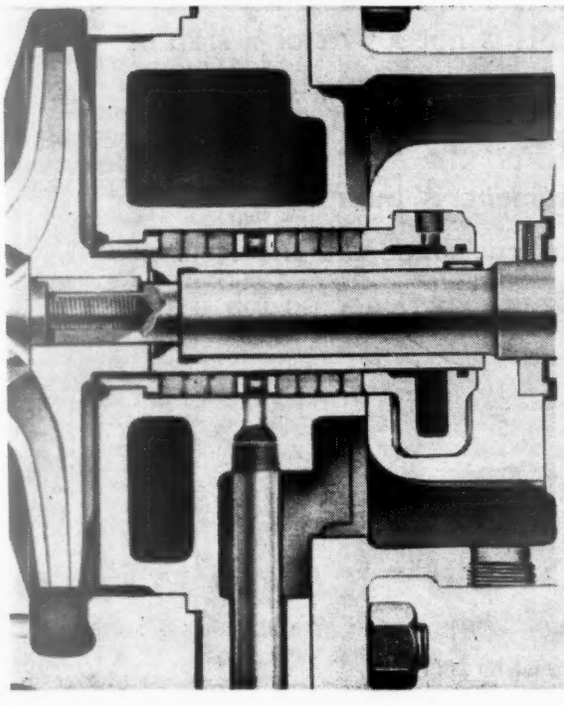
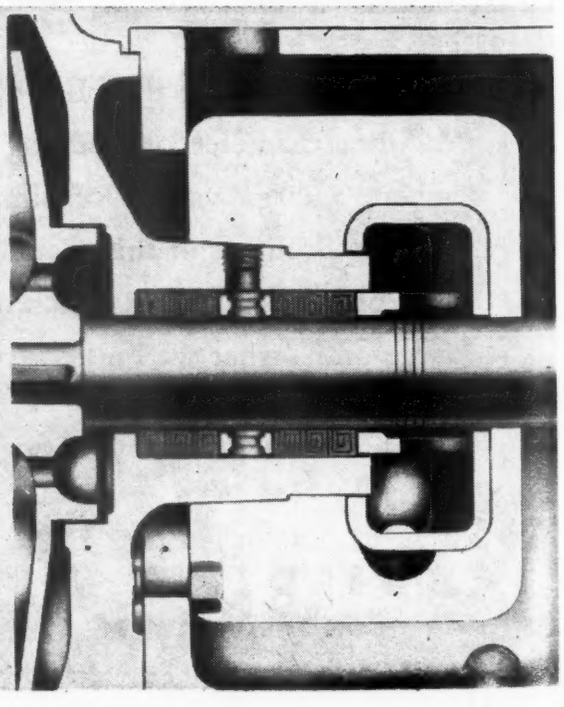
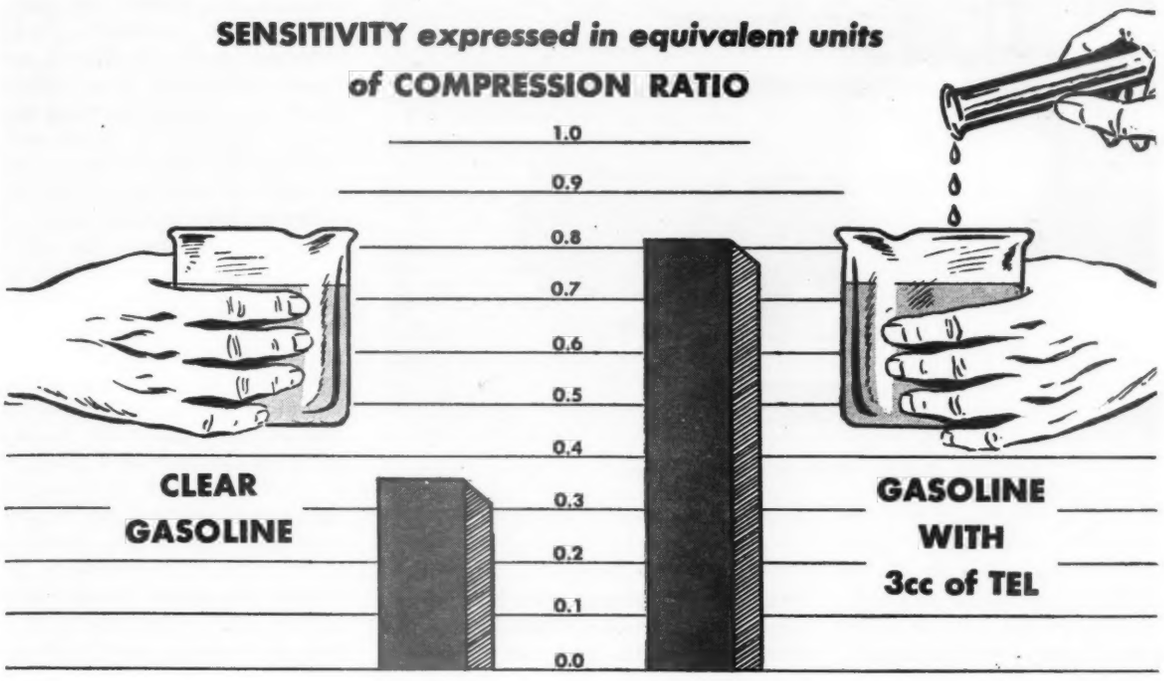


FIG. 9. "Leakollector" gland.



Extra "Sensitivity" of Leaded Gasoline

helps refiners meet requirements of modern engines



GENERALLY SPEAKING, the higher the Research octane number of fuels having the same Motor Method rating, the better their performance on the road. The difference between these two ratings is often called "jump" and is one measure of fuel "sensitivity."

In tests of sixty-six regular and premium fuels the difference between the Research and Motor octane numbers was, on the average, greater by 1.3 octane numbers after the addition of 3.0 cc tetraethyllead.

While sensitivity or jump is usually expressed in octane number units, a more realistic evaluation is obtained when it is expressed as equivalent units of compression ratio. This is true because octane units, in terms of engine performance factors, get bigger toward the upper end of the scale. The chart above shows the additional sensitivity contributed by tetraethyllead when measured on the compression ratio basis.

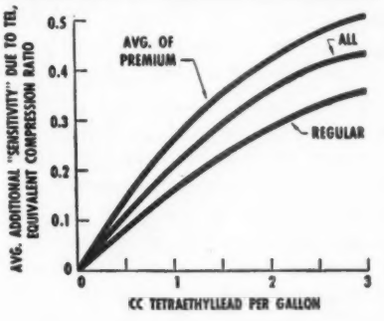
Here the average improvement in sensitivity after the addition of 3.0 cc tetraethyllead is 0.44 ratios. On the average, the sensitivity of leaded fuels is more than twice the sensitivity of the clear fuels, expressed as equivalent units of compression ratio.

Although four of the fuels—on an octane number basis—showed no improvement in sensitivity after the addition of tetraethyllead, *all* of the sixty-six fuels showed an improvement on a compression ratio basis.

Another important finding is shown in the chart at right—the higher the concentration of tetraethyllead, the greater the improvement in sensitivity.

As automobile manufacturers have improved the design of engines by taking advantage of the sensitivity of motor fuels, any feasible method for improving fuel sensitivity without lowering the Motor Method rating has become of distinct advantage to the refiner. In this evolution tetraethyllead has become increasingly valuable through its contribution to fuel sensitivity.

EFFECT OF TEL CONCENTRATION ON "SENSITIVITY" OF COMMERCIAL GASOLINES



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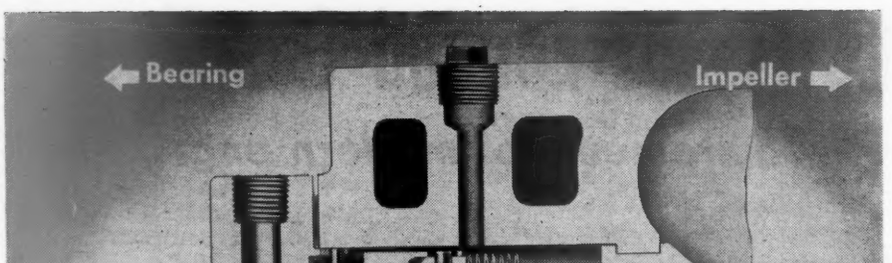


FIG. 10. Single mechanical shaft-seal.

gland by a stationary packing ring. The stationary packing ring serves a dual purpose of sealing off any liquid tending to leak behind the stationary seal ring, and also of providing flexibility to allow the seal face to align itself exactly perpendicular to the axis of rotation and to follow the slight "wobble" of the rotating seal face caused by shaft whip.

The rotating seal ring is usually stainless steel with a Stellite face, and is arranged to be driven positively from the shaft sleeve while still being free to have a limited endwise travel to compensate for shaft expansion or seal face wear. It is sealed to, and flexibly mounted on, the shaft sleeve by an endless V-ring, the ring being spread by a bevelled follower and a set of disc springs. The springs furnish the necessary force to hold the seal closed under zero stuffing box pressure conditions. As soon as pressure exists in the box, additional force is applied to the rotating sealing ring by virtue of the areas exposed to the pressure. The seal is "balanced" so that the increased face pressure is in correct ratio to the liquid pressure to insure adequate sealing without excessive contact loading between the faces. Single seals are regularly applied to light ends at pressures up to 400 lb and on heavier stock to 600 lb.

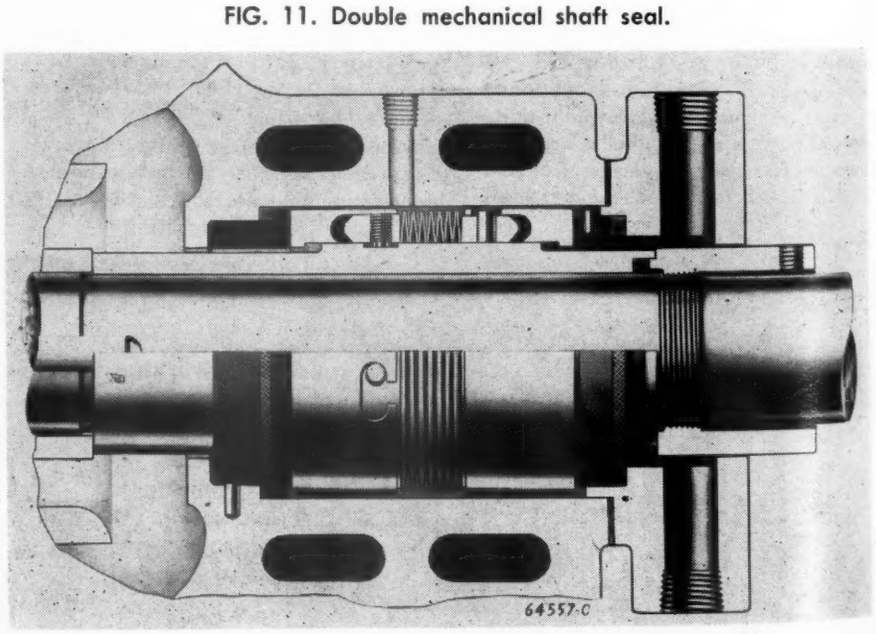
For dirty or corrosive liquids, or where it is desirable to cool the seal, a double seal (Fig. 11) is used. A double seal consists of two single seals back to back, the parts being interchangeable for corresponding sizes. Sealing liquid is dead-ended or circulated between the seal members at a pressure slightly higher than the liquid pressure in the pump. As a double seal requires a complicated seal-oil system, it is only used where single seals cannot possibly work.

Proper selection of type and materials brings a pump into the world under favorable circumstances. It is then up to the operating and maintenance personnel to "raise it to be a useful citizen". Maintenance may be divided into two phases; first, routine adjustments and servicing which may be thought of as "preventive" maintenance, and second "reconditioning" maintenance, when the unit reaches a stage of wear where it must be removed from service and rebuilt.

A good routine of preventive maintenance can extend the periods between major overhauls. Packing for instance, needs intelligent servicing. Large refineries have adopted the practice of having packing specialists whose job it is to adjust and renew packing. Packing technique is an outgrowth of experience, and it is far better to have this experience concentrated in a few men who will be able to cope with any packing problem rather than have the experience scattered haphazardly over dozens of operators, none of whom has enough experience to be an expert. As an illustration: An experienced packing man will tighten a gland one flat at a time, allowing the increased gland pressure to gradually work backward through the rings of packing. An inexperienced man will tighten the gland nuts as many turns as is necessary to immediately reduce the leakage, which puts all the load on the outer ring of packing and usually results in a scored shaft sleeve at this point. Likewise, the decision when to add a ring or when to repack completely is mainly a matter of experience in feeling whether the set has been compressed until it has lost its "spring".

The need for an adequate lubrication program has been stressed so often that the details will not be discussed in this article. The two main factors are basic: Sufficient lubricant

FIG. 11. Double mechanical shaft seal.



of the proper grade for the service, and periodic changes to remove condensation and contamination. A large percentage of the condensation of moisture in bearings and oil sumps can be prevented by throttling the cooling water until the outlet temperature is over 100 F. Under the subject of lubrication, don't forget the gear-type coupling. Oil will escape and evaporate despite the best of precautions, and periodic replenishment will prevent tooth wear. Fast's couplings call for a lubricant no lighter than SAE 70, no heavier than a heavy gear oil. Waldron calls for SAE-40 lube oil.

There comes a time in the life of any pump when it needs to be overhauled. This brings up the question, "What are the external signs of need of overhaul?" Shortage of capacity or head developed indicates increased sealing ring clearances or heavy corrosion of the interior parts. The effect of ring clearance varies with the type of pump. A small capacity high head pump is much more affected than a large capacity low head unit. For this reason, a set value of maximum clearance increase cannot be laid down for all units.

Vibration of the unit may be due only to coupling misalignment, but more likely is indicative of a sprung shaft or unbalance due to uneven corrosion. A sprung shaft can be detected by indicating the shaft just outside the stuffing box while rotating the unit by hand. Of course, this will not show the maximum runout existing inside the unit, but it will be indicative.

Any unusual mechanical noise should be cause for investigation. It may be only a ball bearing failure, but also may indicate foreign material in the pump, broken rotor parts or a broken shaft.

A leaky stuffing box that cannot be repacked successfully is probably caused by a worn shaft sleeve. Actually the sleeve should always be examined before repacking the box, as it is a waste of good packing to put it on a grooved or scored sleeve. Mechanical seals with abnormal leakage require dismantling for inspection, reworking or replacement of parts.

If possible, the pump should be moved into the shop when a complete overhaul is needed. A higher standard of cleanliness can be obtained in the shop, and better lifting facilities, tools, etc., are available. During the dismantling procedure, locations of impellers on the shaft should be measured and recorded for future reference when reassembling the unit. After the rotor is completely stripped, the shaft should be indicated for trueness. It is generally better to support the shaft for indication by means of rollers or V-blocks riding on the bearing fits rather than by means of centers, as very often the original shaft centers have become damaged or burred. Shafts should run within .002 in. and if runout is greater the shaft should be straightened or thrown away. Other causes for shaft rejection are wear at important areas, corrosion, or fatigue cracks. The last item is most likely to occur on large double-suction pumps where radial loads may have been imposed due to operation at reduced capacities.

The impeller wearing rings and casing wearing rings should be measured with micrometers to determine the actual clearance of the used parts. If worn excessively, they should be replaced. Impeller rings are attached to the hubs either by tack welding or by pinning.

Shaft sleeves should be replaced if scored heavily. A lightly scored sleeve, provided it is not just case hardened may be reground to provide a new surface, but there is a definite limit to the amount of reduction in diameter that can be tolerated. Reducing the OD of the sleeve increases the clearance between the sleeve and the throat bushing, also between the sleeve and gland, and if these clearances are too great, the packing will squeeze under. A sleeve too small in diameter provides a poor fit for die-formed packing rings.

Impeller hubs, intermediate sleeve faces and the like should be checked for trueness and refaced to a true perpendicular if needed. It is impossible to assemble a true-running rotor if the component faces are not true or are burred. A solid arbor for refacing is preferable, as an expansion arbor often allows the part to get cocked and a poor job results. Repeated refacing of hubs in multi-stage rotors may result in short stage-to-stage dimensions, and if so, they may be re-established by inserting a carefully machined shim between pairs of faces. Often these shims can be made from an old intermediate sleeve.

Ball bearings that have seen any service should be replaced. Except for extra large bearings, the cost is nominal and it is not worth the risk to reuse the old bearings. Bearing housings should be carefully cleaned with solvent, and any rust resulting from water in the oil should be removed with a wire brush or scraper.

Reassembly of the rotor should be no problem if the individual parts have been properly prepared. After the rotor is assembled and tightened, the assembly should be indicated for concentricity and runout, again supporting the shaft under the bearing areas or by the bearing assemblies themselves rather than on centers. Runout on impeller hubs or on intermediate sleeves should not exceed .005 in. indicator reading (.0025 in. eccentricity) at any point, and on shaft sleeves, the less the better. A rotor that indicates well all along except for one fit means that this particular fit is off with respect to its bore. On the other hand, if all fits show a gradually increasing runout toward a maximum somewhere in the rotor and all high sides are in line, there is a non-perpendicular or burred face somewhere near the maximum runout. The "nigger-in-the-wood-pile" may be found by removing the keys and blueing each hub against its neighbor. A little lapping compound will remove a burr, but if the face is too far off, it should be refaced on an arbor.

In assembling ball bearings, the byword is cleanliness. Keep the bearing wrapped in its protective oiled paper until ready to assemble it on the rotor, and then warm the inner race with hot oil or by careful use of a torch so that the bearing will slide in place. If it is necessary to drive the bearing, drive against the inner race only.

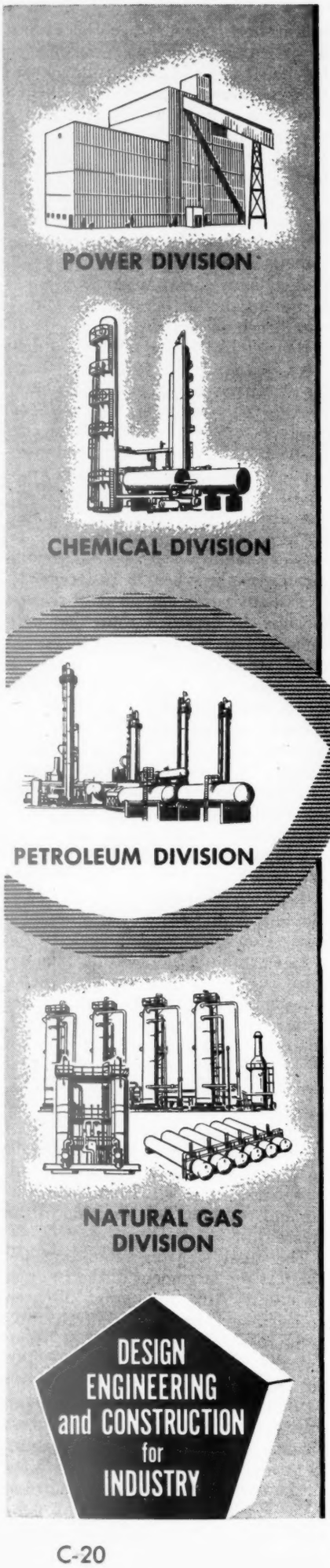
Grease-packed ball bearings should be filled only one-third to one-half full, as excess grease will cause overheating and resultant deterioration of the grease.

The final step in rebuilding the pump is the alignment of the rotor in the casing. After the casing has been reassembled, check the centralization of the rotor in the stuffing boxes. Theoretically, a rotor properly centered in the boxes, should turn freely without a rub, but sometimes it is necessary to shift the rotor slightly to get the best turning position. A rub will cause premature wear or even seizure so it need not be emphasized that a free-turning rotor is a must. * * *

CNGA Publication

A. C. Lyles, chairman of the Technical Committee of the California Natural Gasoline Association announced the completion of Bulletin TS-501.

This bulletin, "Tentative Standard Procedure for the Determination of Carbon Dioxide and Oxygen in Natural Gases" is intended as an operating manual for the analyst in the laboratory and in the field. Included are test procedures for laboratory and field determinations. Copies may be obtained from California Natural Gasoline Association, 510 W. 6th Street, Los Angeles 14, California.



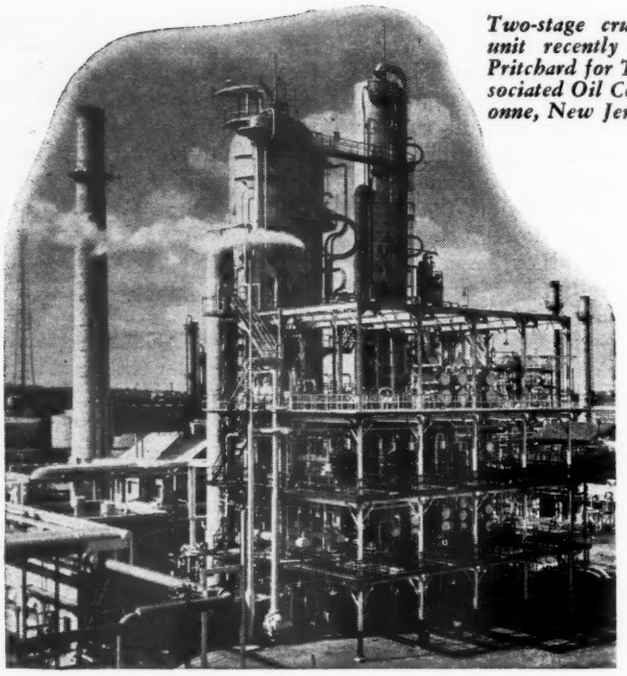


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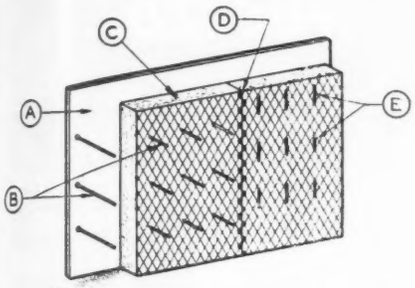
FIG. 1. Wire spotting method for fastening mineral wool insulation on a surface.



A, heated metal surface; B, wires; C, blanket insulation; D, lacing wire; E, wires bent over on face of insulation.

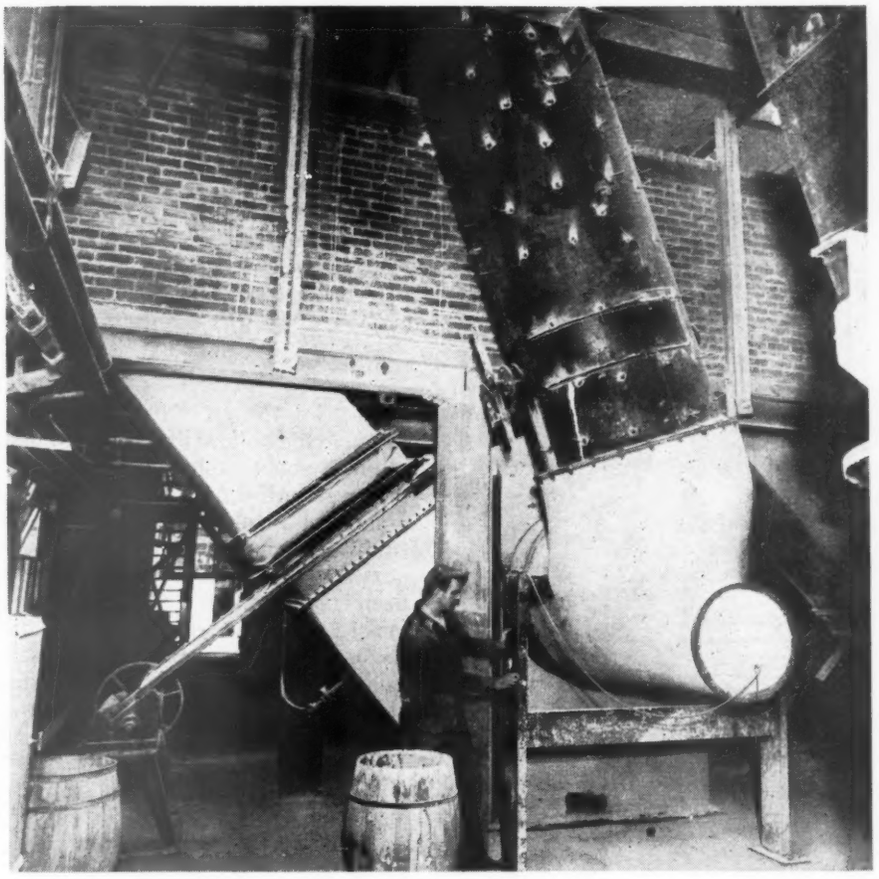


FIG. 2. Insulation wire-spotted on an exhaust fan duct.

Wire-Spotting Technique for Insulation

Application of mineral wool blanket insulation to sheet-metal surfaces can be accomplished by spot-welding galvanized wires

RICHARD L. DAVIS*

FLAT and curved metal surfaces at oil refining and gas processing installations are often difficult to insulate properly because they cannot be punctured by bolts and screws and are difficult to band because of location or shape. This problem is solved easily and effectively by a versatile insulating techinque employing lengths of galvanized wires spot-welded to the sheet-metal surfaces.

This technique of applying mineral wool blanket insulation to metal surfaces is indicated in the accompanying diagram. The recommended application procedure—from bare metal through insulating cement—is as follows:

(1) Dirt, rust, and other extraneous materials are cleaned from the metal surface with a wire brush.

(2) Lengths of No. 9-gage galvanized wire are spot-welded to the metal surface on specified centers.

(3) Mineral wool blankets, supplied sandwiched between expanded metal lath and light-gage wire mesh, are impaled on the projecting wires, lath side out. The protruding wires are then bent over and hooked onto the lath to hold the insulation.

(4) The sections of blanketing, closely butted together, are laced at the edges by No. 16-gage galvanized wires intwined in the metal lath.

(5) A ½-in. of insulating cement is trowelled to the surface of the metal lath.

The lengths of the galvanized wires depend upon the thickness of the blanket insulation. Recommended minimum insulation thicknesses for specified metal surface temperatures are given in the table (from Commercial Standard CS117-49, "Mineral Wool Insulation for Heated Industrial Equipment"). The No. 9-gage wires should be cut longer than the insulation thickness (3 in. longer is sufficient) so that each can be bent over and hooked into the metal lath.

The spacing of the welded wires depends upon the orientation of the metal surface to be insulated. A horizontal surface where the insulation is held vertically by the wires alone (for

*Secretary, Industrial Mineral Wool Institute, 441 Lexington Avenue, New York 17, New York.

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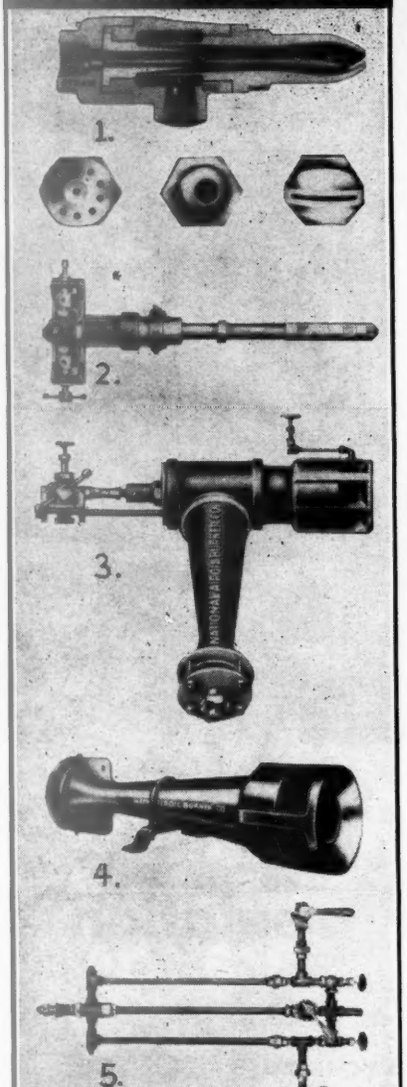

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Blanket insulation—recommended minimum thickness.	
Temperature—F	Thickness—inches
Up to 300	1
300 to 500	1½
500 to 700	2
700 to 900	2½
900 to 1,100	3
1,100 to 1,200	3½

FIG. 3

example the bottom of a storage tank) requires about a 6-in. spacing of wires to insure uniform support of the mineral wool blankets. On a horizontal surface where the insulation is supported in most part by the surface itself (such as the top of the same tank), 18-in. spacing of wire is satisfactory. On vertical surfaces (the sides of the tank) 12 in. is a reasonable spacing of the wires.

Outdoor Installations

An asphalt mastic finish over the insulating cement is vital in outdoor locations where the insulation is exposed to moisture or abrasion. First, after the insulating cement has completely dried. 1-in. galvanized wire netting is stretched tightly over the cement and wired in place with No. 16-gage galvanized wire. The asphalt mastic is then trowelled over the wire netting to a minimum dry thickness of $\frac{1}{8}$-in. (approximately $\frac{1}{4}$-in. when wet). Two coats of lead-in-oil paint applied over a priming coat of aluminum paint is often specified as additional finish.

On indoor installations, a canvas covering or a painted asphalt mastic finish, applied exactly as given for outdoor locations, is often specified for added effectiveness and appearance. When a canvas jacket is specified, 6- or 8-oz. canvas is sewed or pasted smoothly in place over the dry insulating cement and then painted.

The "wire-spotting" method described is illustrated in the photograph as applied to a cylindrical duct leading to an exhaust fan. The lower portion of the duct at the bend has been insulated and the insulating cement applied. Above the insulated section, the wire lengths spotted over the duct surface are in position for installation of blanket mineral wool.

"Wire-spotting" is only one of several carefully designed techniques, applied throughout the petroleum industry, for securing insulation to metal surfaces of heated equipment of all types ranging from ducting and heat exchangers to storage tanks and fractionation units. * * *

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Thermodynamics of Natural Gas Compression

Basic equations are developed, then integrated for isothermal and for non-flow adiabatic compression work; single and multi-stage considerations are presented with calculation examples.

G. L. FARRAR*

THERE is little or no need to point out the numerous applications of compression of hydrocarbon gases in refining and natural gasoline work. There is need, however, to promote better understanding of the basic principles of gas compression and to make clearer the application of these principles to a given compression problem. It should be stated at the outset that apart from the basic theory, the development of this subject will be pointed directly to reciprocating compressors. Space requirements preclude consideration of centrifugal compressors.

In the presentation of this subject, the basic equations will be developed from the first and second laws of thermodynamics. These equations will then be integrated for isothermal work and for non-flow adiabatic work of compression. The treatment will then be extended to single and multi-stage compression.

Basic Equations

The equations used for thermodynamic calculations on compressors are derived from the basic laws of thermodynamics. The first law is based on the premise that energy is not created or destroyed in ordinary processes, and thus that the heat entering or leaving a process is equal to the work done on or by the process, plus the change in "internal energy" of the process. Or,

$$q = \triangle E + W \quad . \quad . \quad . \quad . \quad . \quad (1)$$

q = heat entering or leaving the system
$\triangle E$ = change in internal energy
W = work on or by the process

If, as in the expansion or compression of a gas, the work term is a result of compression or expansion only, an alternate form of Equation (1) may be written:

$$q = \triangle E + \int_{V_1}^{V_2} pdV \quad . \quad . \quad . \quad (2)$$

p = absolute system pressure
V = volume of gas

In differential form,

$$dq = dE + pdV \quad . \quad . \quad . \quad . \quad (3)$$

As no phase change occurs in expansion or compression of a gas, the change in internal energy is characterized by a change in temperature. By definition,

$dE = CvdT$
Cv = specific heat at constant volume
T = absolute temperature

Thus,

$$dq = CvdT + pdV$$

The enthalpy of a substance is defined by the relationship,

$$H = E + pV$$

In differential form,

$$dH = dE + pdV + Vdp \quad . \quad . \quad (4)$$

When no phase change occurs, by definition,

$$dH = CpdT \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

Combining (3), (4), and (5)

$$dq = dH - Vdp = CpdT - Vdp \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

If the fluid to be handled may be considered as a perfect gas,

$$V = \frac{RT}{p}$$

and,

$$dq = CpdT - RT\frac{dp}{p} \quad . \quad . \quad . \quad (7)$$

It is possible to define a variable heat capacity C, such that,

$$dq = CdT$$

It may be shown rigorously[1] that C may be written in terms of Cp, Cv, V and P, the final equation being,

$$dq = C_i \left(\frac{dV}{V} + CvT\frac{dp}{p} \right) \quad . \quad (8)$$

Isothermal Compression

For an isothermal compression, Equation (2) becomes, for an ideal gas

$$q = W = \int_{V_1}^{V_2} pdV = RT \int_{V_1}^{V_2} \frac{dV}{V} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

Also, from Equation (6)

$$dq = -RT\frac{dp}{p}, \text{ under isothermal conditions}$$

$$q = -RT \int_{p_1}^{p_2} \frac{dp}{p}$$

$$q = -RT \ln \left(\frac{p_2}{p_1} \right) / \text{mol} = W \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

For a nonideal gas, the heat and work of compression may be obtained in two general ways. If compressibility data are available, these data may be plotted and the curve graphically integrated from V_1 to V_2, and from the pV curve down to the $p = 0$ axis. The resultant area is the work of compression. If an equation of state (such as van der Waal's, Beattie-Bridgman, etc.) is applicable, Equation (6), or an alternate form, may be integrated to obtain the heat of compression. Again, the integration of pdV will give the work done.

The isothermal work of compression is the minimum amount of work required to compress a gas over a given definite pressure range. In commercial practice, it is not possible to remove the heat of compression as it is formed. In an actual compressor, only a small fraction of the heat is removed, and the operation is very close to adiabatic (no removal of heat) and there is a significant temperature increase on compression.

Adiabatic Compression

The heat transferred in a reversible, adiabatic process is zero. Consequently Equation (8) becomes,

$$Cp\frac{dV}{V} + Cv\frac{dp}{p} = 0$$

$$\frac{Cp}{Cv}\frac{dV}{V} + \frac{dp}{p} = 0 \quad . \quad (11)$$

$\frac{Cp}{Cv}$ may either be assumed constant over the ranges usually encountered in compression work (both for ideal and real gases) or an average value of this ratio may be used. Thus,

$$\frac{Cp}{Cv} = k \quad . \quad . \quad . \quad . \quad . \quad (12)$$

Integrating Equation (11),

*Assistant Professor of Chemical Engineering, Texas A. & M. College.

[1] "Chemical Engineering Thermodynamics," B. F. Dodge, McGraw-Hill Book Company, pages 91, 264, 265.

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$$k \ln V + \ln p = K_1'$$

or,

$$pV^k = e^{K_1'} = K_1 ;$$
$$pV^k = p_1V_1^k = p_2V_2^k \quad . \quad . \quad (13)$$

Substituting relationships from the ideal gas law,

$$TV^{k-1} = K_2$$
$$T^k p^{1-k} = K_3' ; \quad . \quad . \quad (14)$$

$$T(p)^{\frac{1-k}{k}} = K_3 ;$$

$$\frac{T_1}{T_2} = \left(\frac{p_1}{p_2}\right)^{\frac{k-1}{k}} \quad . \quad . \quad (15)$$

It has been pointed out previously that k is assumed constant in the integration (or an average value for k is used). Calculated data for air[2] show a 15.7 per cent variation in k at 0 F, in going from 0 to 4000 psia; at a temperature of 600 F, the variation is 5.8 per cent over the same pressure range. At 4000 psia, the variation is 10.5 per cent in going from 0 to 600 F, while at 0 psia the variation is negligible over the same temperature range. These values give some idea of the variation in k that can be expected.

Edmister[3] shows the variation in k for a number of hydrocarbons, as a function of reduced temperature and pressure. It is advisable to determine k at the entrance and exit conditions and take an average in making compression calculations.

Karassik[4] has listed k's for several gases including several hydrocarbons:

Table 1

Specific Heat Ratios for Gases
(60 F and 14.7 psia)

Gas	Specific Heat Ratio = k
Butane	1.11
Ethane	1.22
Ethylene	1.22
Hexane	1.08
Hydrogen	1.41
Iso-butane	1.11
Methane	1.32
Pentane	1.40
Propane	1.15
Air	1.41
Flue Gas	1.40
Natural Gas* (Approx. Avg.)	1.27
Refinery Gas* (Approx. Avg.)	1.20
Steam (212 F)	1.33

*To obtain exact characteristics the exact constituents must be known.

Where other data are not available, k may be estimated by the relationship,

$$k = \frac{Cp}{Cp - 1.987},$$

where Cp is the molal heat capacity.

When a mixture of gases is being compressed, the value of k is obtained for each component. Then the arithmetic molal average k is computed. This is done by finding the mol fraction of each constituent in the mixture, multiplying k for a given constituent by its mol fraction, and then summing the (k × mol fraction) terms.

As energy is being put into an adiabatic compression and no energy is being removed, the temperature must rise as the compression is carried out. The manner in which the temperature rises is shown in Fig. 1. Data for this figure were calculated from the expression,

$$\frac{T_1}{T_2} = \left(\frac{p_1}{p_2}\right)^{\frac{k-1}{k}} \text{ Eqn (15)}$$

The entrance temperature is assumed to be 100 F.

Non-Flow Equations and Calculations

Work for a non-flow adiabatic process may be found from the general work equation and Equations (13) through (15).

$$W = \int_{V_1}^{V_2} pdV \; ; \quad p = \frac{p_1V_1^k}{V^k}$$

$$W = p_1V_1^k \int_{V_1}^{V_2} \frac{dV}{V^k}$$

$$W = \frac{p_1V_1^k}{1-k}\left(V_2^{1-k} - V_1^{1-k}\right)$$

$$p_1 = p_2\frac{V_2^k}{V_1^k}$$

$$W = \frac{p_1V_1 - p_2V_2}{k-1} \quad . \quad . \quad . \quad (16)$$

As V_2 is unknown, the relationship,

$$V_2 = V_1\left(\frac{p_2}{p_1}\right)^{-1/k}$$

will be used to substitute for it. Then,

$$W = p_1V_1\left[1 - \left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}}\right]$$
$$. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (17)$$

$$W = nRT_1\left[1 - \left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}}\right]$$
$$. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (18)$$

The subscript, 1, refers to *inlet* conditions. These two equations give the theoretical work of adiabatic compression for an ideal gas. It holds remarkably well for real gases, however, not in the two-phase region, except at very high pressures. Example 1 is given below to illustrate the use of this equation.

Example 1: 1000 ft³ of methane at 60 F and 1 atmosphere are compressed adiabatically to 10 atmospheres in one minute. Calculate the theoretical work required for the compression and the exit temperature of the gas. k for methane may be taken to be 1.30 under these conditions.

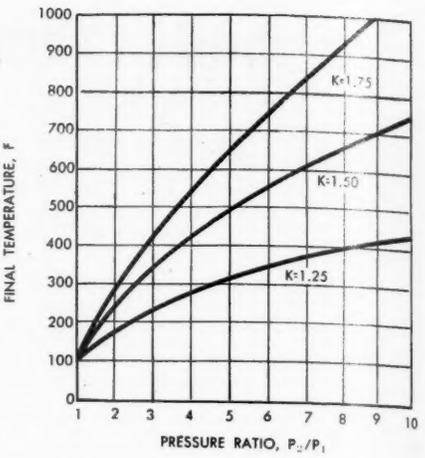

FIG. 1. Temperature of adiabatic compression.

Solution:

$$W = \frac{p_1V_1}{k-1}\left[1 - \left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}}\right] \quad \text{(Eq'n. 26)}$$

$$W = \frac{14.7\times144\times1000}{1.30-1}\left[1-(10)^{\frac{0.30}{1.30}}\right]$$

$$W = 7.06 \times 10^6\,[1 - 1.70]$$
$$W = -4.95 \times 10^6 \text{ ft lb/min}$$
$$W = \frac{-4.95\times10^6}{33{,}000} = -150 \text{ hp}$$

The negative sign means that work is required to be done on the system. Thus, power is required to carry out the compression. It should be noted that had the gas expanded from 10 atmospheres to 1 atmosphere, the system would have been capable of doing work. The sign for W in this case would have been positive since

$$\left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}}$$

would have been less than one.

$$T_2 = T_1\left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}} \quad \text{(Eq'n. 15)}$$

$$T_2 = 520\,(10)^{\frac{0.30}{1.30}} = 520 \times 1.70$$
$$T_2 = 884 \text{ R} = 424 \text{ F}$$

Single-Stage Compression

The discussion of compression thus far has dealt only with the compression of a gas from one state to another, without considering the steps required to return from the final state to the initial state. In any given reciprocating compressor, a certain amount of gas is compressed in the cylinder as the piston moves toward the end of the cylinder. When the pressure becomes sufficiently high, the exhaust valve opens and most of the gas is discharged. All of the gas cannot be discharged since the piston would have

[2] "Chemical Engineering Thermodynamics," B. F. Dodge, McGraw-Hill Book Company, page 270.
[3] Edmister, W. C., Ind. Eng. Chem., 32, 373, 1940.
[4] Karassik, I. J., Chemical Engineering, page 132, November, 1947.

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to hit the end of the cylinder in this case. The residual amount of material in the cylinder then expands as the piston moves back to suction position. At this point more feed gas is introduced into the cylinder, and the cycle is again completed.

Thus, a study of compression in an actual compressor requires that the entire cycle be considered. The pressure-volume relationships in an actual compressor, assuming adiabatic compression and expansion, may be approximated by the cycle shown in Fig. 2. The net work of the cycle may be obtained by algebraically adding the work required for each change. Or,

$$W\left(\begin{matrix}\text{cycle}\\ 1\text{-}2\text{-}3\text{-}4\end{matrix}\right) = W_{1\text{-}2} + W_{2\text{-}3} + W_{3\text{-}4} + W_{4\text{-}1} \quad \ldots\ldots\ldots\ldots \quad (19)$$

In order to obtain an expression as simple as possible for W cycle the "no-clearance" cycles, $_{1\text{-}2\text{-}b\text{-}a}$ and $_{4\text{-}3\text{-}b\text{-}a}$, will be considered. $W_{1\text{-}2\text{-}3\text{-}4}$ will then be $(W_{1\text{-}2\text{-}b\text{-}a}) - (W_{4\text{-}3\text{-}b\text{-}a})$.

$$W_{1\text{-}2\text{-}b\text{-}a} = W_{1\text{-}2} + W_{2\text{-}b} + W_{b\text{-}a} + W_{a\text{-}1} = \frac{p_1V_1}{k-1}\left[1-\left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}}\right] - p_2V_2 + 0 + p_1V_1.$$

From Equations (16) and (17)

$$p_1V_1 - p_2V_2 = p_1V_1\left[1-\left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}}\right]$$

Thus,

$$W_{1\text{-}2\text{-}b\text{-}a} = \left[\frac{p_1V_1}{k-1} + p_1V_1\right]\left[1-\left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}}\right]$$

$$W_{1\text{-}2\text{-}b\text{-}a} = \frac{k\,p_1V_1}{k-1}\left[1-\left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}}\right]$$

By the same line of reasoning,

$$W_{4\text{-}3\text{-}b\text{-}a} = \frac{k\,p_4V_4}{k-1}\left[1-\left(\frac{p_3}{p_4}\right)^{\frac{k-1}{k}}\right]$$

However,

$$p_3 = p_2;\ p_4 = p_1$$

Then,

$$W_{4\text{-}3\text{-}b\text{-}a} = \frac{k\,p_1V}{k-1}\left[1-\left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}}\right]$$

And

$$W_{1\text{-}2\text{-}3\text{-}4} = \frac{k\,p_1V_1}{k-1}\left[1-\left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}}\right] - \frac{k\,p_1V_4}{k-1}\left[1-\left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}}\right] = \frac{k\,p_1\,(V_1-V_4)}{k-1}\left[1-\left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}}\right]$$

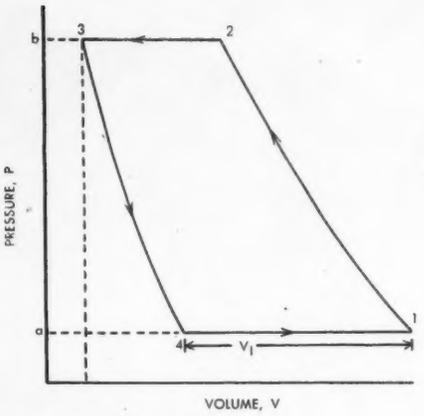

FIG. 2. P-V relationships in single-stage compression.

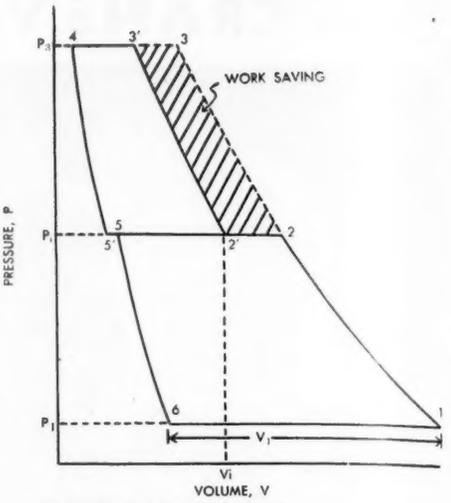

FIG. 3. P-V relationships in two-stage compression.

Note that V_1 is the volume at the end of the intake stroke and V_4 is the volume at the beginning of the intake stroke. Thus, $V_1 - V_4 = V_I$, where V_I = net intake volume. The cycle work now becomes,

$$W\text{ cycle} = \frac{k\,p_1\,V_I}{k-1}\left[1-\left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}}\right] \quad \ldots\ldots\ldots\ldots \quad (20)$$

The work for any number of cycles is then determined by using the volume, V_I, corresponding to that number of cycles.

Multi-Stage Compression

It has been shown in Fig. 1 that the temperature increases rapidly with compression ratio in adiabatic compression. At high temperatures, lubrication of the compressor becomes difficult; too, at a high compression ratio, the compressor cylinder must be large to hold the relatively large volume of gas at low pressure and strong to withstand the high pressure reached after compression. Also, as will presently be shown, the work for a given compression is reduced if the process is carried out in more than one step. For all these reasons, if the overall compression ratio is greater than 6 or 7, multi-stage operation is used. The gas is cooled between stages by means of heat exchangers known as intercoolers.

The reduction in required work when using multi-stage compression is shown in Fig. 3. The lower part of the diagram shows the first-stage cycle. If all the compression were carried out in one stage (or if there were no intercooling between stages) the adiabatic compression path would be 1-2-3. If, however, the exit gas from stage 1 is cooled at the interstage pressure, the gas volume decreases from V_2 to V_2'. The compression path in the second stage would then be from 2′ to 3′. The area 2-2′-3′-3 represents a saving in work applied to the compressor, as it is area under a p-V curve.

It is worthy of note that the required work of compression will decrease as the number of stages is increased. The limit of the work saving will approach the difference between adiabatic work and isothermal work, as the number of stages continues to increase.

The work of two-stage compression is the sum of the required work in each stage.

$$W_{2\text{ stg.}} = \frac{k\,p_1\,V_I}{k-1}\left[1-\left(\frac{p_i}{p}\right)^{\frac{k-1}{k}}\right] + \frac{k\,p_i\,(V_2'-V_5)}{k-1}\left[1-\left(\frac{p_3}{p_i}\right)^{\frac{k-1}{k}}\right]$$

Let $V_2' - V_5 = V_{Ii}$ = inlet volume to the second stage.

If the gas from the first stage is cooled to the temperature of the inlet gas,

$$p_1V_I = p_iV_{Ii}$$

Then, $W_{2\text{ stg.}} =$

$$\frac{k\,p_1V_I}{k-1}\left[2-\left(\frac{p_i}{p_1}\right)^{\frac{k-1}{k}}-\left(\frac{p_3}{p_i}\right)^{\frac{k-1}{k}}\right]$$

It can be shown that for n stages,

$$W_n = \frac{k\,p_1V_I}{k-1}\left[n-\left(\frac{p_{i1}}{p_1}\right)^{\frac{k-1}{k}}-\left(\frac{p_{i2}}{p_{i1}}\right)^{\frac{k-1}{k}}-\ldots\ldots-\left(\frac{P_f}{p_{i\,(n-1)}}\right)^{\frac{k-1}{k}}\right] \quad (21)$$

P_f = outlet pressure from n^{th} stage. It is now desired to find the relative values of the interstage pressures at which minimum work is required. This can be done by differentiating the work in Equation (21) with re-

spect to each of the interstage pressures. This technique requires the use of partial differentiation, and it is felt that this is beyond the scope of this article. Thus, the result will be set down without performing the mathematics. The interested reader is referred to Dodge[5] for the detailed steps involved.

The pressure ratio per stage

$$= \frac{p_{i_1}}{p_1} = \frac{p_{i_2}}{p_{i_1}} = \ldots = \frac{p_f}{p_{i\,(n-1)}}$$

or

pressure ratio per stage

$$= \sqrt[n]{\frac{p_f}{p_1}}$$

Thus it is seen that minimum work is attained when the pressure ratio is the same in all stages. Substituting Equation (22) into Equation (21),

$$W_n = \frac{kp_1V_1}{k-1}\left[n - n\left(\frac{p_f}{p_1}\right)^{\frac{k-1}{nk}}\right]$$

$$= \frac{nkp_1V_1}{k-1}\left[1 - \left(\frac{p_f}{p_1}\right)^{\frac{k-1}{nk}}\right] \quad \ldots \quad (23)$$

Most compressors are thus designed to give equal work in each stage.

An example problem is given below to show the use of Equation (23) and to compare the work of single and multi-stage compressors.

Example 2: It is desired to compress 1000 ft³/min of a natural gas from 15 psia to 150 psia. The gas inlet temperature is 80 F. An analysis of the gas shows substantially 70 mol per cent methane and 30 mol per cent ethane. Compare the required work for 1, 2, and 3-stage adiabatic operation with the isothermal work. Assume the gas is cooled to 80 F in each interstage cooler. Calculate the interstage pressures for the multistage operations.

Solution: k for the mixture will first be estimated.

Assume k about 1.3; then final temp. will be about 400 F @ $p_2/p_1 = 10$ (From Fig. 1)

Using Edmister's[3] equation,

$k = 1 + C\,(k_3 - 1)$

From propane plot in Edmister's article,

k_3 @ 80 F and 15 psia = 1.11

k_3 @ 400 F and 150 psia = 1.13

k_3 avg. = 1.12

$k\,(CH_4) = 1 + 3.5\,(1.12 - 1) = 1.42$

$k\,(C_2H_4) = 1 + 1.58\,(1.12 - 1) = 1.19$

k avg. =

$1.42 \times 0.70 + 1.19 \times 0.30 = 1.35$

Close enough to assumption of 1.3.

Single-Stage Work (Eq'n. 20)

$$W = \frac{1.35 \times 15 \times 144 \times 1000}{0.35 \times 33{,}000}\left[1 - (10)^{\frac{0.35}{1.35}}\right]$$

$W = 252\,[1 - 1.82]$

$W = -207$ hp.

Two-Stage Work (Eq'n. 23)

$$W = \frac{2 \times 1.35 \times 15 \times 1000 \times 144}{0.35}\left[1 - (10)^{\frac{0.35}{2.70}}\right]$$

$W = 504\,[1 - 1.348]$

$W = -175$ hp

Three-Stage Work (Eq'n. 31)

$$W = \frac{3 \times 135 \times 15 \times 1000 \times 144}{0.35 \times 33{,}000}\left[1 - (10)^{\frac{0.35}{4.05}}\right]$$

$$W = 756\left[1 - (10)^{\frac{0.35}{4.05}}\right]$$

$W = 756\,[1 - 1.22]$

$W = -166$ hp.

Isothermal Work

The least required work is isothermal work.

From Equation (10), $W = -nRT \ln \left(\frac{p_2}{p_1}\right) = -p_1V_1 \ln \left(\frac{p_2}{p_1}\right)$

[5] "Chemical Engineering Thermodynamics," B. F. Dodge, McGraw-Hill Book Company, page 281.

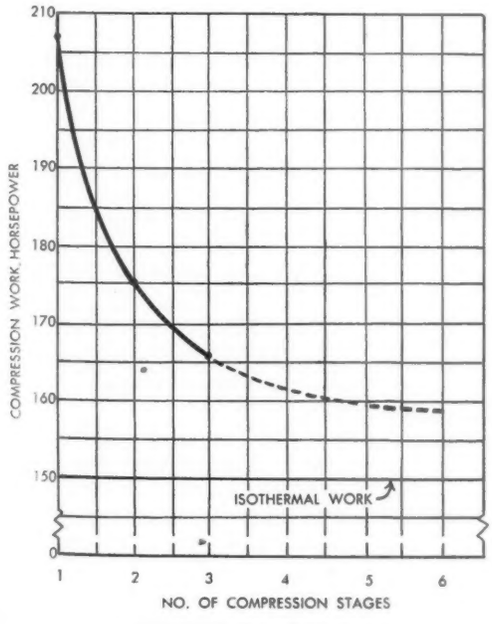

FIG. 4. Required work for compression.

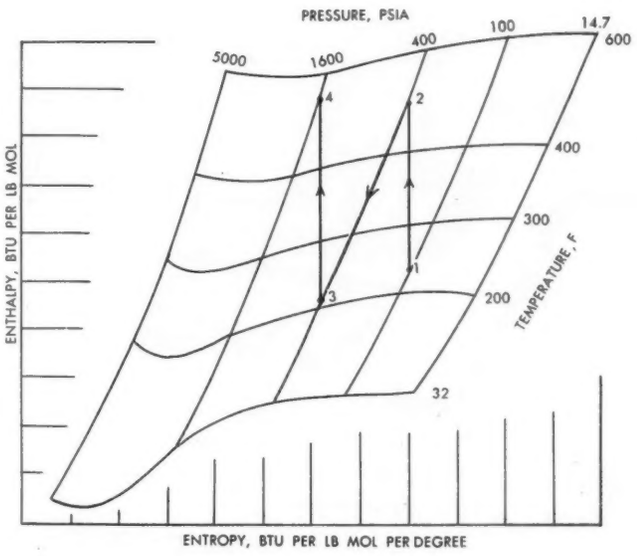

FIG. 5. Thermodynamic chart for natural gas.

$$\text{Isothermal work} = \frac{-15 \times 144 \times 1000 \times 2.303}{33{,}000} = -151 \text{ hp}$$

The curve in Fig. 4 shows required work for this compression as a function of the number of stages, thus showing that very little advantage is obtained by increasing the stages beyond 5 or 6.

Compression Ratios

Two-Stage, compression ratio $= \sqrt{10} = 3.16$
Interstage pressure $= 47.4$ psia $= (3.16)(15)$

Three-Stage, compression ratio $= \sqrt[3]{10} = 2.155$
Interstage pressures $= 32.3$ psia and 69.6 psia

Compression of Nonideal Gases

Cycle work for an adiabatic process involving a nonideal gas may be obtained from the thermodynamic diagram for the material being compressed. For an adiabatic process,

$$W = p_1V_1 - p_2V_2 + \int_{V_1}^{V_2} pdV$$

From (Eq'ns. 16 and 17)
From first law of thermodynamics,
At $q = 0$, $W = -\triangle E$

$$\int_{V_1}^{V_2} pdV = -(E_2 - E_1)$$

$$W = p_1V_1 - p_2V_2 - (E_2 - E_1)$$
$$W = (p_1V_1 + E_1) - (p_2V_2 + E_2) = H_1 - H_2$$
$$W = -\triangle H$$

Thus it is necessary only to obtain H values on the adiabatic (isentropic) line, at the two pressures corresponding to entrance and exit conditions. For a multi-stage process, the $-\triangle H$ values are obtained for each stage and added to obtain W. This process is indicated in Fig. 5. Path 1-2 shows first-stage compression, while Path 3-4 shows second-stage compression. Path 2-3 shows the constant pressure cooling in the intercooler.

Thermodynamic charts for natural gases have been prepared by Brown[6] from compressibility data. These are recommended for use. In using these charts, it is necessary to determine the gravity of the gas in use and choose the proper chart accordingly.

A more complete discussion of compression of nonideal natural gas mixtures has been presented by Ridgway.[7] The reader is referred to this article for more complete treatment of the subject.

[6]G. G. Brown, Pet. Tech., July, 1947, TP 1747.
[7]R. S. Ridgway, *Petroleum Refiner*, Vol. 24, No. 5, May 1945.

★ ★ ★

Sinclair Completes Venezuelan Refinery

Sinclair Oil and Refining Company has announced the completion and placing into operation of its Venezuelan refinery almost three months ahead of contractural obligations with the Venezuelan government. Although final figures are not complete, it is estimated that the new Puerto de la Cruz refinery will not exceed original figure of about $20,000,000.

The new refinery is situated adjacent to Sinclair's crude oil loading terminal on Chaure Bay. It has a daily crude oil charging capacity of 35,000 bbl and will process crude oil into gasoline, kerosine, heating oil, and residual oil.

It will be served by a 100-mile pipe line extending from the Santa Barbara field northward and connecting with other east Venezuelan producing areas. A total of 1,500,000 bbl of tankage have been erected as part of the refinery project. The pipe line system has a capacity of 50,000 bbl of crude daily, and will supply refinery requirements as well as provide for continued shipments to the U. S.

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Fuel Oil Stability Tests*

THE purpose of this memorandum is to discuss briefly the various test methods being used in the industry to study domestic fuel oil stability, and to outline the methods used by the Du Pont petroleum laboratory for evaluating the effectiveness of experimental stabilizers.

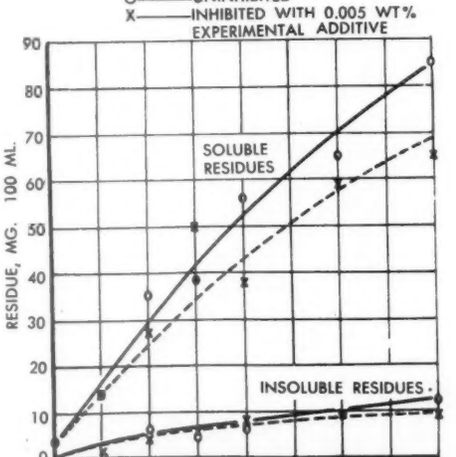
One of the main problems encountered in studying the stability of distillate fuel oils (domestic heating oils) is the selection of appropriate test methods. As there is, at present, no definition of adequate stability in terms of any one test method, it is necessary to use a fuel of known service performance as a reference standard and then select the test method that provides satisfactory correlation with field experience in a reasonable time.

Test Methods

There are many methods in current usage and the one that is best for one study may not be at all suitable for another. For example, if color stability is the principal problem, the tests employed may be quite different from those used when strainer-clogging is the difficulty. For convenience, the methods that are known to be used can be classified into three general categories as follows:

1. Methods that indicate the condition of the fuel at the time of test but do not provide information regarding its future condition.
   A moderate comprehensive list would include:
   a. Color; NPA, Lovibond, or other.
   b. Sediment by filtration usually expressed as mg/100 ml.
   c. Carbon residue (Conradson or Ramsbottom) on 10 per cent bottoms.
      This method shows a relationship with soluble residues measured by evaporative methods but is also a function of boiling range and composition (ease of cracking).
   d. Air jet gum by ASTM D 381-46 or by the General Motors' modification of the same method.
      The latter employs an evaporation temperature of approximately 385 F, which may be attained by using ethylene glycol or a mixture of diethylene glycol and water. These methods have the advantage of employing standard equipment, however, due to the rather long evaporation time required and the contact of air with the oil, considerable gum may be formed during the determination, particularly with unstable fuels. Also, as the evaporation time is a function of boiling range, the reproducibility is apt to be poor, and determinations on fuels of varying boiling range and stability, not comparable.
   e. Steam jet evaporation, proposed by a panel of Section 4 of ASTM Technical Committee E.
      This method uses the ASTM air jet modified to substitute steam in place of air and to operate at temperatures up to 600 F. The reproducibility is fair and has the added advantage over the methods previously described in that the evaporation time is shortened considerably and air is excluded from the sample during the evaporation, thus minimizing the effects of oxidation.
   f. Evaporative methods employing vacuum and inert gases such as CO_2 (see Dickey and Henry, Ind. Eng. Chem. Analy. Ed. 16, 710, 1944).
      Although such methods are known to be reproducible, they usually have the disadvantage of being more complex and requiring more elaborate equipment than other evaporative methods.
   g. Acid flocculation (see Proel and Bolt, Oil and Gas Journal 44. No. 47, 1946).
      This procedure gives results that, in general, parallel the results obtained by evaporative methods. The reproducibility is good.
   h. Alcoholic extractions (see Smith and Shannon, Refiner, 18, No. 2. February, 1939).
      Residues are measured by evaporating to dryness ethanol extracts of the oil.
   i. Emulsion tests.
      Qualitative measurement of the presence of organic acids capable of forming metal soaps.
2. Methods that accelerate the deterioration of the fuel prior to determining its condition by procedures in the first category.
   Accelerating conditions that have been employed are:
   a. Light exposure (sunlight and ultraviolet)
   b. Elevated temperatures
   c. Oxygen-rich atmospheres
   d. Metallic catalysts such as copper. Oil soluble compounds of the metal, e.g., copper oleates, may also be used.
      Frequently several of these accelerants are used simultaneously.

FIG. 1



Although the rate of deterioration can be readily increased by the methods listed above, considerable caution is required in the interpretation of the results obtained. In studies made by the Du Pont petroleum laboratory, none of the accelerated methods employing elevated temperatures (above 110 F), have proved completely satisfactory as they all have failed in one way or another to correlate with storage at normal temperatures. For example, the effects of adjuvants may vary considerably depending upon the test temperature employed.

An illustration of this effect is provided by data obtained using an accelerated bomb test (212 F and 100 psig oxygen pressure) and a storage test (110 F with an atmosphere of air). From the results of the former, tabulated below, it would be expected that a significant improvement in the storage stability of the fuel would

*Du Pont petroleum laboratories.

be obtained by the use of the additive. The storage data, plotted in Fig. 1, however, indicate that the experimental additive was essentially ineffective.

Accelerated Data

(10 hr Aging at 212 F and 100 psig Oxygen)

	Residue, Mg/100 ml. Soluble	Insoluble
F-1209 (Catalytic Cracked Fuel Oil)	87-108	14-16
F-1209 + 0.005 wt. % Experimental Additive	35-32	4-2

The use of light as an accelerant introduces a number of variables that are difficult to control such as uniformity and intensity of light source and transmission properties of the containers used. Also, it is questionable whether the photochemical reactions that take place would be representative of the reactions that occur in normal storage. Consequently, laboratory storage in glass, in the dark, with or without metal present, has been selected by the petroleum laboratory as representing the most useful test for studying stability. A temperature of 110 F is frequently employed. This temperature accelerates the test moderately, but the data obtained are consistent with room temperature storage results.

3. Methods that simulate service conditions.

Three such methods involving the circulation of test fuel, through the components of a domestic heating installation with a return line in two cases, and of a diesel engine injector system in the other, have been used on a limited scale. (See Hersberger, Cowles and Zieber, Ind. Eng. Ch. 35, 1104-07, 1943.) Sufficient information to estimate the probable usefulness of these methods is not yet available. Because of the involved equipment required, it seems probable that such methods will be useful mainly in the development of better test methods rather than for the study of specific fuel problems.

Another test that is thought to simulate service conditions is outdoor drum storage of the fuels. This procedure as conducted by the Du Pont petroleum laboratory consists essentially in storing approximately 30-gallon samples of fuel in vented, 55-gal steel drums. At monthly intervals, color and soluble residues (steam jet gum) are determined and at the end of the storage period (6 to 12 months) insoluble residues are determined by filtration and solution of the adhering residues in acetone and methanol, which is later evaporated to dryness. Although this method is believed to be reliable, its usefulness is limited as it is extremely cumbersome. In summary, the Du Pont petroleum laboratory, for most studies, uses the 110 F storage method for studying the deterioration of fuels because of the uncertainty regarding the significance of accelerated test results at higher temperatures. Color, insoluble residue, and steam jet gum determinations are made on the stored samples at appropriate times. It should be noted that while the storage containers are vented, they are also flushed with air at weekly intervals to insure an adequate supply of air in contact with the oil. Copies of the methods used by the Du Pont petroleum laboratory may be obtained from your petroleum chemicals division representative.

General Information

The stability of straight run (virgin) distillate fuels has generally proved to be satisfactory in storage and use, although there have been exceptions (see Hersberger et al). Thermal cracked fuels have also been satisfactory if properly treated although the quantities of such fuels marketed are believed to be relatively small. Treatment with sulfuric acid followed by neutralization and redistillation has been most commonly used, although clay treatment has also been employed. Blends of straight run and treated thermal stocks have been marketed successfully as have blends with untreated thermal stocks, in low percentages and under special conditions. Catalytic cracked stocks are of quite variable stability depending upon the process, operating conditions, and charging stocks. Caustic washing has improved the color, gum stability, and responsiveness of some catalytic cracked fuels to additives. Thiophenols and mercaptans in these fuels have detrimental effects.

When stabilizers are used, it has been found necessary to introduce them into the fuel at the earliest possible moment in order to secure maximum effectiveness.

On various occasions, reports from the field have indicated that incompatibility of blending stocks may exist. This is thought to be due to the solvent properties of the stocks. Thermal stocks are known to possess good solvency for their deterioration products, while the solvencies of catalytic and particularly straight run distillates are relatively poor. It is suspected, therefore, that gum that is soluble in a thermal distillate may be precipitated from solution when blended in certain critical ratios with straight run or possibly catalytic stocks.

Typical Evaluation Program

A typical program that could be conducted by a refiner concerned with determining the best method of preparing a stable fuel for sale is described below.

The following conditions are assumed to exist:

1. It is desirable to use minimum quantities of straight run stocks.
2. Fuel previously marketed, which had proved satisfactory in service, consisted of a variable blend of straight run and acid-treated, redistilled thermal stocks.
3. A catalytic cracked stock of unknown stability is now available for blending. A blend of only catalytic and thermal stocks would be desirable if practical.
4. Caustic washing facilities for the catalytic cracked fuel are available.
5. None of the blending stocks require sweetening.
6. A fuel oil antioxidant (Additive "A") is to be evaluated.

The program would then consist of storage tests at moderate temperature (room temperature to 110 F) to evaluate the experimental blends, with and without additive, and with and without caustic treatment, against a fuel of known stability. The following samples are suggested:

1. A sample representing the previously marketed fuel of satisfactory stability.
2. Two blends covering the expected blending ratios of thermal and catalytic cracked stocks.
3. No. 2 plus two concentrations of Additive "A".
4. One or two blends of the straight run stock (25 to 50 per cent with one or both of the cracked blends (sample 2 above).
5. No. 4 plus two concentrations of Additive "A".
6. Repeat in total or spot check the samples from No. 2 to No. 5 after caustic washing, water washing, and filtering the catalytic blending stock.

The stored samples should be tested at biweekly or other suitable intervals (depending on the temperature employed) for color, soluble residue, and insoluble residue. In laboratories lacking facilities for the two residue determinations, a careful visual examination of the samples may provide information regarding the relative insoluble residue content. Such a program could be completed in 4 to 6 months.

* * *

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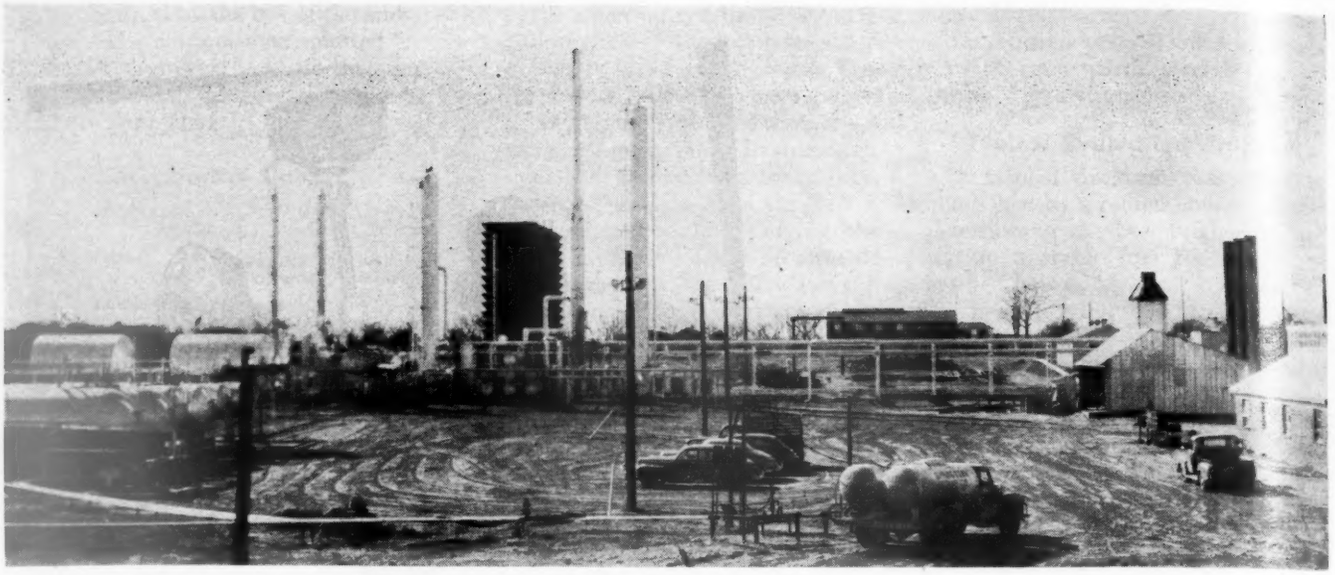


Looking west is view of entire plant, office and warehouse, storage and loading facilities.

"Most Economical" Gas Plant

E. D. SOLTES*

Construction Costs Reduced to Minimum to Recover Natural Gasoline, 80 Per Cent Butane, 75 Per Cent Propane.

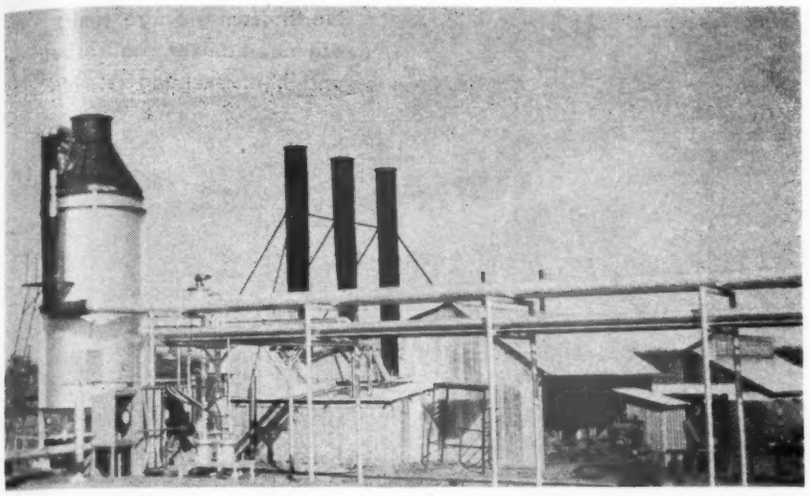
THE recently completed Upham Gas Company's gasoline plant at Mineral Wells, Texas, is an example of the manner in which a small producing group can build and operate a gasoline plant with a minimum of capital expenditure. The plant is of modern, conventional design, and although it was specifically designed for high recovery under varying gas conditions and production of three separate products, the cost of the plant was only slightly more than that for a standard "packaged" unit with a much lower recovery at the same gas throughput. Most "standardized packaged" units are designed for high pressure absorption and in order to achieve a high propane recovery at the lower pressures, such a unit would have to be redesigned for the specific case and would lose any cost advantage that the "package" affords. Despite the individual design and attention to detail, the capital investment per gallon of liquid product for the Brazos River plant was about the same as that normally encountered for a plant with four to five times the processing capacity.

Before the construction of the plant was begun, an economic study of the Brazos River situation was made in order that the most economical choice of a processing scheme could be made. Three cases were proposed: Low propane recovery, 26 per cent propane, 80 per cent butane; medium propane recovery, 75 per cent propane; and high propane recovery, 95 per cent propane, (Hypersorption). A process design for each case was prepared and a tentative estimate of the cost of each type of plant and its gross return was made. From the data assembled, the producer decided upon the medium propane recovery system. A detailed process and mechanical design was then prepared on this basis and construction of the present plant was started.

As the principal function of the gas system is to supply gas to the local consumers, the plant operation is secondary to proper operation of the gas distribution system. The system is unique in that the gathered wet gas is brought into the plant where it is processed and sent directly from the plant to local municipal and industrial consumers. The plant absorber functions essentially as an integral part of the gas system, much the same as a separator or treater, with the gas passing directly from field to consumer. The absence of compression and large pipeline outlets common to most low pressure gasoline plants means that both the absorber pressure and gas throughput vary with consumer demand. The daily and seasonal demands for gas govern the operating pressures and quantity of gas processed by the plant, the daily demand loads for gas following those of the other utilities. The seasonal demand for the gas means that during cold weather, approximately twice the summer gas rate must be processed by the plant. The

*Process Engineer, Robert L. Purvin, Consulting Engineer.

EXCLUSIVE



Looking east is view of boilers, which are now housed, rich oil heater, and oil pipe lanes.

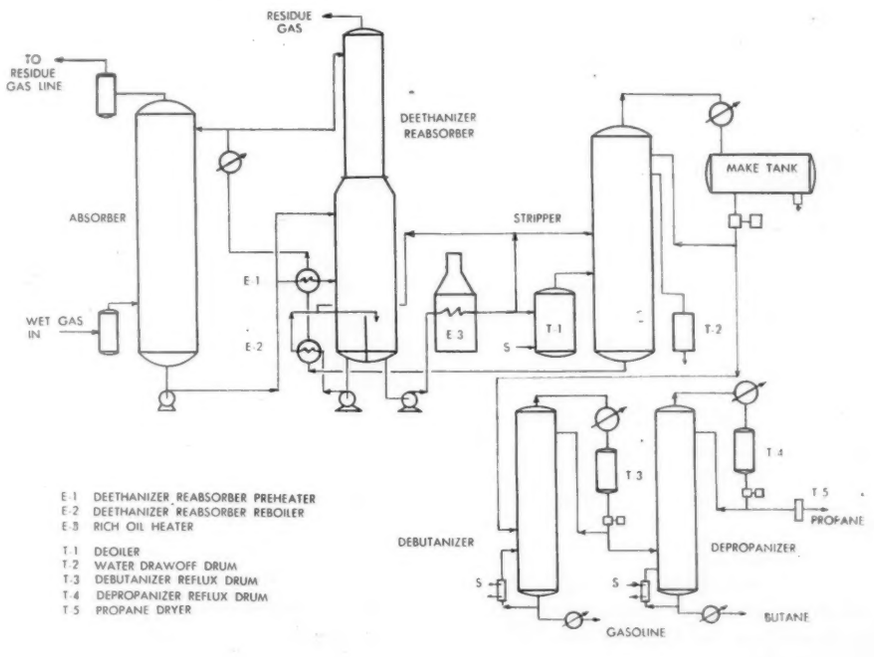
gas conditions fluctuate, depending upon the gas rate, from 5,000,000 std cu ft per day and a corresponding peak pressure of 150 psig to a peak load of 10,000,000 std cu ft per day and 75 psig.

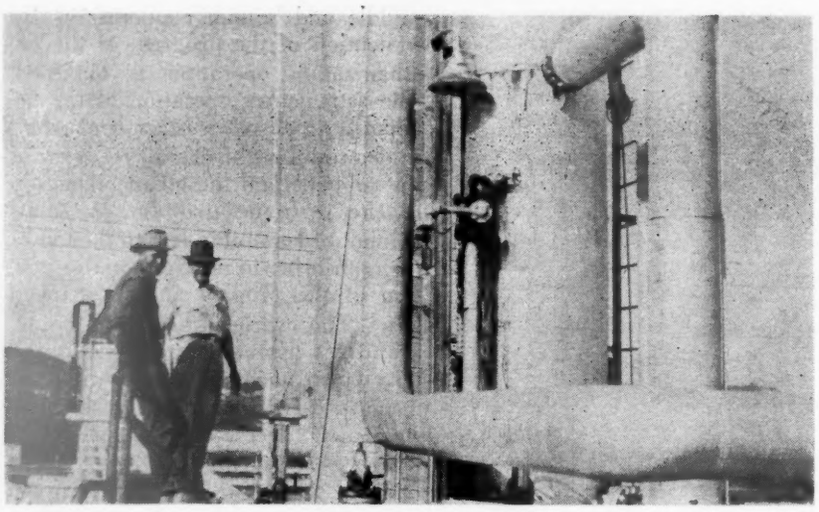
The plant was designed to handle from 7,000,000 to 14,000,000 std cu ft per day of wet gas at pressures ranging from 75 to 200 psig. The wet gas contains approximately two gallons of recoverable liquid per thousand cubic feet, of which over 50 per cent is propane. The plant was designed for the recovery of 75 per cent of the propane and essentially all of the butanes and heavier. The products are a commercial propane, commercial butane, and 18/70 natural gasoline. If desired, essentially pure propane and butane and a debutanized natural gasoline could be produced.

The design provides for a low pressure absorber, deethanizer reabsorber, rich oil stripper, debutanizer, depropanizer, and product storage. A deethanizer reabsorber was incorporated in the design to effect the high propane recovery and complete deethanization in a single unit. A unique method of heat exchange around the deethanizer was employed and differs slightly from those heretofore presented. This innovation removes the necessity of a second reboiler pump and some additional instrumentation.

The wet gas is brought into the plant from the field gathering system, passes through the absorber and returns to the residue system for distribution. No refrigeration or intercooling in the absorber was necessary and the temperature of the lean oil achieved in the cooling tower was sufficiently low to insure the high propane recovery. A maximum pressure drop of 5 psig is allowed for processing the gas. The absorber operating pressure depends upon the gas pressure and when that pressure is above 125 psig, the rich oil from the absorber will flow without pumping through the deethanizer reabsorber preheater and into the tower that operates at 100 psig. A portion of the rich oil from the absorber is bypassed around the preheater and sent directly to the tower as reflux for the stripping section, the remainder of the rich oil being preheated by exchange with the hot lean oil. The preheater was used instead of a secondary reboiler and the operation proved to be very satisfactory. The control of the unit is simplified and by observing the middle and bottom temperatures, an indication of the progress of the deethanization operation is obtained. The satisfactory operation of the deethanizer reabsorber is very important in determining the overall recovery of the propane and the ethane retention in the propane product. A small amount of lean oil is sent to the top of the reabsorber to recover a major portion of the propane in the stripped gases. The overhead gas from the deethanizer reabsorber is returned through a knock out drum to the residue gas line. Rich oil from the cold side of the deethanizer bottom partition is exchanged in the deethanizer reboiler with hot lean oil from the stripper bottom. The lean oil then flows from the reboiler through the deethanizer preheater to the lean oil pumps. A temperature control valve maintains a constant temperature on the lean oil outlet from the deethanizer preheater and provides a means of control for the deethanizer bottom temperature. The rich oil from the hot side of the deethanizer is pumped through the rich oil heater to the stripper. The rich oil heater is a 6,500,000 btu per hr vertical all-radiant type iso-flow heater. Another operating feature incorporated in this design is a connection between the rich oil heater outlet line back to the deethanizer reboiler outlet line. In this way, some additional heat may be obtained in the deethanizer reabsorber during peak loading periods when the exchange equipment is being taxed to provide

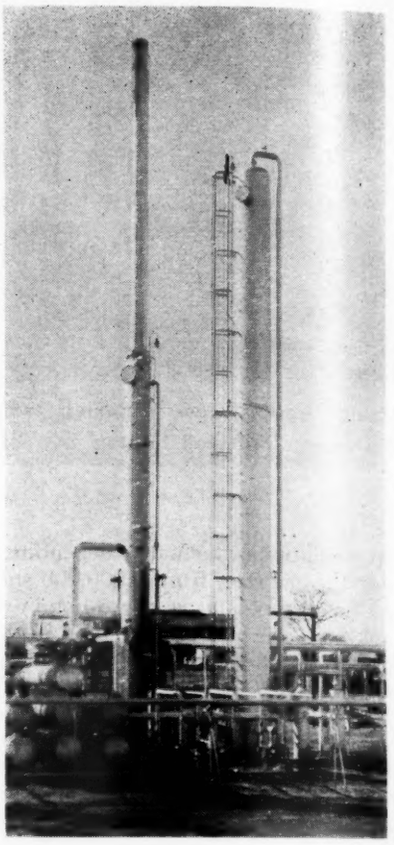
Diagram of Upham Gas Company's plant.





Superintendent Homer Foley, right, and operator on elevated platform beside deethanizer reabsorber, elevated control valve.

North from storage tanks are deethanizer reabsorber and heat exchangers.



sufficient heat for adequate stripping. An adjustable check valve in the hot oil line from the heater to the stripper provides an adequate control on the heater outlet pressure so that hot rich oil may be returned to the deethanizer, and also serves as a check valve for the line. The hot rich oil is steam stripped in the rich oil stripper, and the hot lean oil bottoms is exchanged in the deethanizer reabsorber preheater and reboiler, cooled in atmospheric sections in the cooling tower, and returned to the system. A small portion of the rich oil is sent to the deoiler where it is steam stripped to remove the lean oil and lighter, leaving as bottoms the heavy ends and other undesirable material that tend to build up in the lean oil and must be drained from the system.

The overhead products from the stripper are condensed and cooled in atmospheric sections and collected in the make tank. The make tank liquid is pumped to the debutanizer where an 18/70 natural gasoline is produced as a bottoms product. The gasoline is cooled and sent to storage without additional treatment. The overhead is cooled and sent to the depropanizer where commercial butane is produced as a bottoms product and the overhead product is a commercial propane. The products are cooled and sent to storage. The propane is dried before entering the propane storage tanks. Adequate storage for one week's production is provided. Facilities are provided for tank truck loading at the plant site.

Turbine-driven centrifugal pumps are employed for the oil and cooling water pumps with reciprocating pumps in the other services. Steam for the pumps and process is provided at 250 psig by three 150-hp oil field type boilers. Internally treated water from the Mineral Wells municipal supply provides makeup for the cooling tower and boilers. A natural draft cooling tower with atmospheric cooling sections is used for the cooling service. Instruments are pneumatically operated with dry gas from the residue system. A single building provides housing for the materials warehouse, laboratory, and office.

The design deleted all elaborate construction features for the sake of economy and only the items necessary for easy operation and complete operating information were included. This deletion in no way impaired the plant efficiency and sufficient control data are available so that complete plant tests can be performed at any time. Economies employed in the design neither violate sound methods nor sacrifice ease of operation. All instruments were mounted locally in weather-proof cases and grouped so that the operator has a clear and rapid indication of the operation of each unit. Wherever possible, common spares for the process pumps were used. In this manner, a savings of four pumps with their auxiliary piping was effected. A considerable savings in piping costs was achieved by grouping the units as close as good practice allows, locating remote units such as heater, boilers, cooling tower, and storage so that a minimum of piping and piping turns are necessary and retaining a majority of the process control valves overhead where they are inspected and serviced by means of an overhead walkway.

Although the system has certain operating problems, there are several natural advantages that contribute to the processing and economic picture; namely, the gas processed is sweet and the products require no additional sweetening treatment and the products are marketed in the local area.

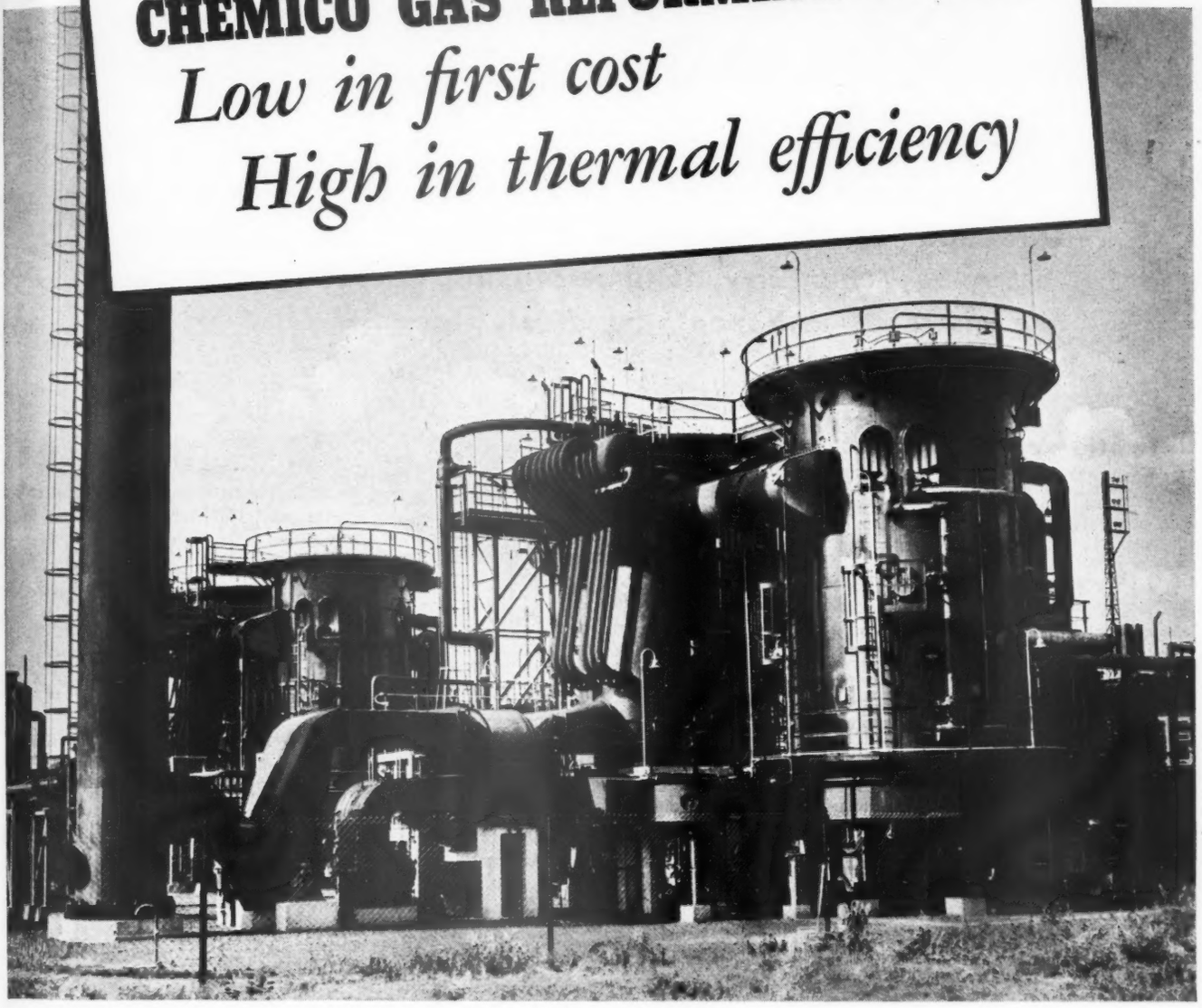
The plant operation has been satisfactory. Control of such important features as tower temperatures and pressures and product specifications has been achieved with ease. Shutdown and startup operations require a minimum of time, approximately 14 hours being required for a startup from a point at which no oil is in the system to regular operation.

A plant recovery test was made one month after the plant startup and the results indicate that the design requirements are being satisfied.

Process design and supervision of operation was provided by Robert L. Purvin, Consulting Chemical Engineers, Dallas, Texas, and mechanical design was handled by Richard Henry, Dallas, Texas. Construction was by company personnel with supervision by C. R. Upham, Jr., vice president of Upham Gas Company, and Homer Foley, plant superintendent. * * *

CHEMICO GAS REFORMING PLANT

Low in first cost
High in thermal efficiency



Among the many types of heavy chemical plants Chemico designs and constructs are those for the production of synthesis gas, principally hydrogen. The gas reforming plant, shown above, is located in the synthetic ammonia works of the Office National Industriel de l'Azote at Toulouse, France. It has been operating successfully for a year and a half.

Other Chemico installations for the catalytic reforming of natural gas have been producing for as long as eight years. The total output of all these plants is more than 180,000,000 cu. ft. of reformed gas per day. Four more plants are now under construction in the United States and foreign countries.

Chemico's design provides important advantages. These plants are low in first cost, high in thermal efficiency. Construction is simple. The plant is foolproof . . . requires a minimum of operating and maintenance attention.

CHEMICO
GAS REFORMING PLANTS
are used for making:

- **Hydrogen-nitrogen mixtures for ammonia synthesis.**
- **Hydrogen and carbon monoxide mixtures for methanol synthesis.**
- **Carrier gas for blending with natural gas for distribution by Public Utilities.**
- **Hydrogen for industrial uses.**

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Chemico plants are profitable investments

THE TECHNICAL FORUM

Questions on the petroleum and natural gas industries' technology, chemistry, engineering, and operating problems are answered each month by widely recognized authorities.

Utilization of Mercaptans

Q What commercial or industrial uses are being made of mercaptans recovered in light oil treating operations?

A Odorants and fuel are the main uses of mercaptans. As many mercaptans are gases at atmospheric temperatures, most operations prefer to burn them in a separate burner with excess gas to assure complete burning.

C. W. Rippie.

Improving Cetane Number

Q What degree of improvement in cetane number and in deposit-forming tendency can be obtained by the selective solvent extraction of diesel fuel fractions and what relationship exists between fuel improvement and extraction loss? What are found to be the most effective extraction solvents so far as it has been reported?—O. D. T.

A It is assumed that the question refers to the production of fuel oils for high-speed diesels, since only such higher priced products can justify the cost of solvent refining at the prevailing conditions.

ASTM Tentative Specification D 975-48T covers fuel oils for this type of service as follows (condensed):

Grade of diesel fuel oil	1-D	2-D
Flash point P. M., °F	100 min. or legal	100 min. or legal
Pour point, °F	20 max.	20 max.
Conradson carbon (on 10% residue), %	.15 max.	.35 max.
ASTM distillation, °F	End Point 625 max.	90% off 675 max.
Viscosity @ 100°F	1.4 csks min.	45" Say. Univ. max.
Sulfur, % wt.	.50 max.	1.0 max.
Copper Strip Corrosion	neg.	neg.
Cetane No.	40 min	40 min.

Major manufacturers of high-speed diesel engines have issued various, more stringent specifications of their own. In general, a good high-speed diesel fuel of current American manufacture may be described as a predominantly paraffinic oil having the following average characteristics:

ASTM Boiling Range	400°F IBP to 700°F EP
Cetane No.	45-50
Flash Point, PM, °F	160—
Viscosity SUS, @ 100°F	40
Sulfur, %	.2-.5
Conradson carbon (on 10% resid.), %	.1

The significance of the above tests is briefly as follows:

Volatility as expressed by the boiling range, and, indirectly, viscosity are needed for assuring complete combustion of the fuel.

Ignition characteristics as expressed by the cetane number, are a safeguard for easy starting and smooth operation.

Conradson carbon on the 10 per cent residue from ASTM distillation and sulfur content indicate the relative freedom from deposit formation in the engine.

From the boiling range of the petroleum stocks involved, it is evident that only lower-boiling selective solvents are suitable for solvent refining of diesel fuel oils. Such solvents are liquid sulfur dioxide (boiling point + 14°F) and furfural (C.p. 323°F). Higher boiling solvents would not lend themselves to easy separation from the raffinate by distillation, in the solvent recovery stage of the process.

The answer to the question regarding the relationship between the expected improvements in quality of diesel oils and extraction losses, must be answered to the effect that it greatly depends upon the original petroleum stock. It was already mentioned that a good diesel fuel oil must be a 400-700°F oil cut, consisting predominantly of paraffinic hydrocarbons. Solvent extraction is essentially a process for increasing the paraffinicity of the hydrocarbon stock, without changing its boiling range.

Now, if the cut derives from straight distillation of e.g., Pennsylvania, Rodessa, or certain light Mid-Continent crudes, it does not need any improvement by solvent extraction, as it is already predominantly paraffinic, and therefore an excellent diesel fuel oil as is.

If the cut derives from straight distillation of a naphthenic crude, the improvements and yields obtainable from solvent extraction may be illustrated by the following examples:

Continued on next page

If the answer to your problem isn't here WRITE US.

This Forum is a meeting place each month for engineers, technologists, students, operators, etc. Each may profit by answers to his own knotty questions and those of others. Answers are supplied by the leading scientists and engineers in the world of oil and gas. Address all questions to

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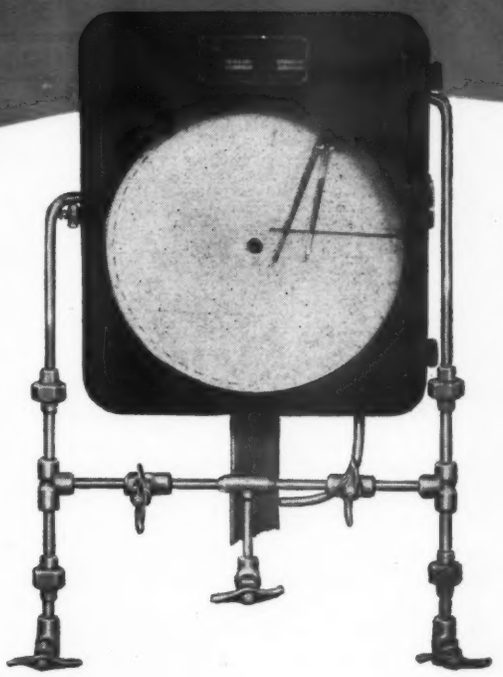
Send them in right away while you think of it.

NEW!

LEAKPROOF STUFFING BOX
Requires No Lubricant



STUFFING BOX FEATURES

The heart of this unit is a combination packing and bearing made of synthetic Teflon. This material is tough, chemically resistant, stands up to 450° F., has a low coefficient of friction. It flows slightly under extreme pressures. Spring loaded follower serves as a pilot to adjust bearing to contours of body and periphery of shaft —seals tight with minimum friction. All other parts are made of stainless steel. Shaft and Teflon bearing may be replaced in the field.

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Now it can be told! For well over a year the new Rockwell stuffing box has been field tested by major pipeline companies and cycling plants on all kinds of gases and pressures. Performance has been outstanding! At one of these cycling plants the new stuffing box is working at flow temperatures of 200° F. and pressures of from 3600 to 4000 psi. Factory tests of this design, *without lubricant,* show absolutely no leakage handling nitrogen at high pressure and free rotation of the shaft under a *torque of only 9.7 inch-grams.* So successful is the new stuffing box that its use is now standard on both high and low pressure Rockwell-Emco orifice meters. Packaged kits for converting meters in service are available. Write for full details.

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The charts from many high pressure meters represent several thousand dollars. Hence accuracy in chart calculation is imperative. The operator of a Rockwell-Emco integrator mechanically computes charts by simply tracing the pressure and differential records made by the meter. The total extension then appears on a direct reading counter, accurate to ½ of 1 per cent or closer.

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Edeleanu Extraction (SO_2) of Diesel Fuel Oils

Product	Charge Str. Run Calif. Dist. 400-700°F Boiling Range	Raffinate	Charge Str. Run Calif. Dist. 400-700°F Boiling Range	Raffinate
Yield, % Vol.	100	77	100	84
Gravity, °API	32.0	37.0	32.0	35.0
Flash, PM, °F	187	189	185	191
Color, ASTM	2½	< 1	< 3	< 1
S. U. V. @ 100%F	37	36	39	39
Pour Point, °F	Below —15	—10	—10	— 5
S, %	.38	.17	.4	.3
Carbon Residue on 10% Bottoms, %	.04	.01	.19	.04
Aniline Point, °F	146	172	143	158
Cetane No.	40	50	41	46

Catalytically cracked fractions of proper boiling range are comparable to straight run cuts from mixed base crudes, as far as yields and quality of solvent-refined diesel fuels are concerned.

Thermally-cracked stocks, however, have too low cetane numbers to start with (in the order of 25-30). They do not lend themselves to solvent-refining into diesel fuels of over 40 cetane even at extraction losses as high as 50 per cent. Consequently, it has not been considered economical to produce solvent-refined diesel fuels from thermally-cracked stocks.

The question regarding the degree of improvement in solvent-refined diesel fuels with respect to deposit-forming tendencies, is the hardest one to answer in a concise manner. A partial answer has been given in the table, specifically by the comparative values of the Conradson carbon and sulfur contents in the respective charges and raffinates.

Engine tests have confirmed the beneficial effect of solvent-refining on the performance characteristics of diesel fuels, but a detailed discussion of this subject is far outside the scope of the Technical Forum. It is suggested that the inquirer be referred to the papers presented at the 1948 SAE Diesel Engine Meeting, particularly two papers on "The Influence of Diesel Fuel Properties on Engine Deposits and Wear", one by G. H. Cloud and A. J. Blackwood, and the other by H. M. Gadebusch.

John Happel

Butadiene Manufacture

Q **What are the controlling factors on yields of butadiene, beginning with (a) a B-B cut containing 50 per cent butene; (b) AC_4-and-lighter cut containing 90 per cent butane (normal)? What are the essential steps in each case? What catalysts are employed?**

C. N. J.

A *General.* Butadiene is now made by the catalytic dehydrogenation of normal butenes according to the following reaction:

$$(1)\quad n\ C_4H_8 = C_4H_6 + H_2$$

This reaction takes place at commercially practical rates at 1150-1250 F and a partial pressure of 0.1 atm. Steam dilution is employed. The catalyst residence time is about 0.2 second, the butene conversion is 28 per cent and the selectivity runs up to 80 per cent. Ultimate yields average out at around 75 per cent. The reactor effluent is then processed with fractionation and extractive distillation or selective absorption for butadiene recovery and purification and for return of the unreacted normal butenes to the dehydrogenation process.

The normal butenes required are obtained from catalytic cracking operations or by the catalytic dehydrogenation of normal butane:

$$(2)\quad n\ C_4H_{10} = n\ C_4H_8 + H_2$$

Typical operating conditions are 1100 F catalyst temperature, 800 hourly space velocity, pressures slightly above atmospheric, butane conversions in the range of 35-40 per cent and ultimate yields of 75 to 80 per cent. The reactor effluent is fractionated and treated by extractive distillation to separate the unreacted normal butane and the normal butenes formed.

As both processes are operated at moderate conversions to obtain higher selectivity it is necessary to recycle the unreacted feed in order to obtain good ultimate yields. These two processes are discussed in turn in more detail below.

Normal Butene Dehydrogenation. While a B-B cut containing 50 per cent normal butenes could be fed to this process a normal butene content of 70 to 90 per cent is desirable. There is no commercially significant difference in the dehydrogenation of the 3 normal butene isomers that in the feed are usually present in proportions of the same magnitude. The higher the butene content the more effective use is made of the dehydrogenation equipment investment. Also the less the load is upon the C_4 separation facilities in which the butadiene is separated for final purification, the olefins recovered for recirculation to the catalyst dehydrogenation unit after admixture with make-up fresh feed, and the lighter hydrocarbon gases are vented from the system. At the catalytic dehydrogenation temperature level of 1150-1250 F butadiene is catalytically cracked, depositing polymeric materials on the catalyst, which in turn form coke that causes the catalyst to lose activity. This coking tendency is offset by low partial pressures that are obtained by steam dilution of the feed to give a butylene partial pressure of about 0.1 atms. This dilution as practiced also serves to minimize non-catalytic cracking of the normal butenes. Although a B-B containing 50 per cent normal butenes doubtless could be used, the general practice in the government rubber program was to use richer normal butene stocks as being more economic.

Dehydrogenation of normal butenes catalytically gives ultimate butadiene yields of approximately 75 per cent whereas thermal dehydrogenation or cracking of normal butenes gives a maximum ultimate butadiene yield of around 40 per cent. The most popular catalyst now being used is believed to be a promoted iron oxide. Recent catalyst developments have been in the direction of a continuous removal of coke from the catalyst by the water gas reaction. To minimize the frequency of catalyst regeneration the dehydrogenation temperature selected is conditioned by the fact that at temperatures above 1300 F the butenes thermally crack in the heaters and transfer lines resulting in loss in yield and coking. Below 1100 F butene conversions at partial pressures of 0.1 atm are less than 40 per cent. The practical range of operation has been found to be 1150 to 1250 F. Butene dehydrogenation to butadiene is an endothermic reaction absorbing 725 Btu per pound of butenes converted. Thus as conversion of butene proceeds heat is absorbed, the temperature drops and the reaction is retarded. The high steam dilution lessens this effect as it is a source of sensible heat. In practice a temperature drop through the catalyst bed of 60 to 70 F is usual. In order to avoid serious thermal cracking, the butene gas stream is heated separately to about 1000 F and abruptly mixed with steam superheated to 1300 F so that the mixture is at the desired reaction temperature as it enters the catalyst chamber. The steam diluent also reacts with the carbon deposit on the catalyst and in the ideal case removes it as rapidly as formed.

The butadiene reactors are about 16 ft in diameter with a catalyst depth of 36 to 42 in. A catalyst life of 5000 hr is not unusual. The effluent gas stream is quenched immediately to 1000 F to minimize the effect of undesirable secondary reactions.

The effluent gas stream is cooled to

permit processing by a combination of fractionation and either extractive distillation with furfural or selective absorption with copper solutions. Rubber Reserve grade butadiene is 98.5 per cent pure with added restrictions on oxygen content, peroxide content, acetylene content, and non-volatile residue.

Normal Butane Dehydrogenation. Normal butane can be converted to butadiene by catalytic dehydrogenation to normal butenes and by their dehydrogenation in turn to butadiene in the manner just described. To utilize normal butane in this manner it should be at least 98 volume per cent pure with isobutane not exceeding 1.5 per cent and isopentane not exceeding 0.5 per cent. The butane should also be free of water that deteriorates the chromia - alumina dehydrogenation catalyst used. In the total feed made up of recycle and fresh feed the normal butene concentration is about 3 per cent. Typical operating conditions are catalyst temperature of 1100 F, pressure slightly above atmospheric and with space velocities of 850. Chromia - alumina catalysts in 1/8 by 1/8 in. cylindrical pellets have shown a life exceeding 100 days. Coke deposition occurs requiring recurrent burning off coke to reactivate the catalyst. Typical conversions are in the range of 25 to 50 per cent with ultimate yields in the range of 66 to 82 per cent depending on space velocity employed and the age of the catalyst.

The catalyst reactor effluent is cooled and subjected to fractionation and extractive distillation to separate the normal butenes for subsequent conversion to butadiene, the normal butane for recycle to this process, and to remove the lighter than C_4 and heavier than C_4 components of the effluent from the system.

There is a one step butane to butadiene catalytic process in which normal butane is fed to the system and butadiene withdrawn from it with recycling of butane and normal butenes. Little is generally known of this operation save that it offered initial difficulty that was later overcome. The plant employing this process is now being reactivated by Rubber Reserve.

Dr. James H. Boyd

Natural Gas Calculations

Q How may the deviation of natural gas from the perfect gas laws be calculated, as for a gas containing, for example, 80 per cent methane, 17 per cent ethane, and 3 per cent propane, by volume?—W. L. T.

A The deviation of Natural Gas from the perfect gas laws may be calculated as set forth in the Natural Gasoline Supply Men's Association Technical Manual on page 50 (Fifth Edition). For example:

(1) Component	(2) Mole fraction	(3) Individual absolute critical temperature °F abs. Tc
CH_4	.80	344
C_2H_6	.17	549
C_3H_8	.03	666
	1.00	

(4) 2 × 3 Absolute pseudo critical temperature Tc	(5) Individual absolute critical pressure lb/sq in abs PC	(6) 2 × 5 Absolute pseudo critical pressure Pc
275.2	673	538.4
93.33	712	121.04
19.98	617	18.51
388.5 °F abs		678.0 lb/sq in. abs

P (Pressure under which gas exists) = 1000 psia

T (Temperature under which gas exists) = 90 F + 460 = 550 F abs

Pr (Reduced Psuedo Pressure) = $P/\underline{Pc} = 1000/678 = 1.47 +$

Tr (Reduced Psuedo Temperature) = $T/\underline{Tc} = 550/388.5 = 1.41 +$

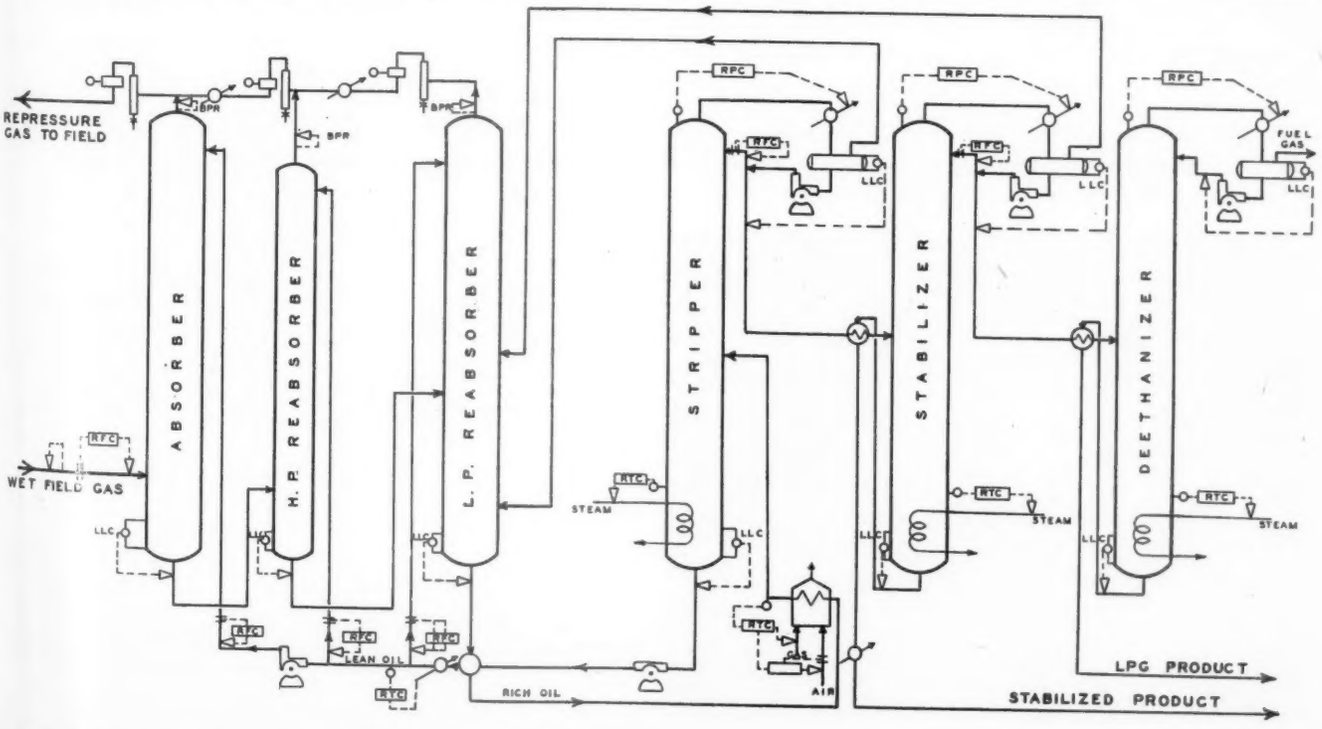
Using Fig. 3, page 52:

Z = PV/RT = .83 Compressibility factor for the above gas @ 1000 psia and 90°F.

F. H. Dotterweich

"INSTRUMENT REQUIREMENTS" FIGURE

In the Technical Forum, page C-17, September 1950 issue of the Refining and Gas Processing Edition, in the first item, "Instrument Requirements", answered by G. L. Farrar and A. M. Platt, "Fig. 1", mentioned in the first paragraph, was inadvertently omitted. This figure is presented herewith and should be filed with the text of the answer for complete coverage of the question and answer to this important question. —Editor.



Petroleum Refinery Instrumentation*

DOUGLAS M. CONSIDINE†

Part 3—Conclusion

Logical Approach to Design of Graphic Panel

Efficient process operation is the primary purpose of any control panel. Reduction in the size of the control room; added ease in training new operators; increased over-all attractiveness of the control room are advantages *only* if accurate, reliable process control is obtained. A soundly designed graphic panel must, first and foremost, fulfill its primary purpose. Over and above this, it must justify its existence by supplying the additional benefits demanded by users of this type of panel.

Bearing in mind the above requirements, what is the logical sequence in designing a properly engineered graphic panel? Several factors must be considered in arriving at an answer to this question.

In constructing a graphic panel, every effort should be made to incorporate standard instrument components which have been proven adequate for the control job at hand. Here the advantages are fairly apparent. Included among them are: Assurance of correct process control; ease of maintenance; readily available service facilities; and easily obtainable replacement parts.

Having assured adequate control as well as simplified maintenance and service by using standard proven control components, it is next necessary to consider how best to obtain those additional benefits which justify the use of the graphic panel. Since ease of operation, conservation of panel space, and a decrease in the time required to train new operators are foremost among the advantages claimed for this type panel, considerable thought should be given to the design of the pictorial flow diagram, and the manner in which the indicators, recorders, and controllers are tied to this diagram. The benefits enumerated can be realized to the greatest extent only if full advantage is taken of the possibilities of arrangement and color combinations.

New Concepts in Graphic Panel Design

In arriving at a logical conclusion to the problem of graphic panel design, it is first necessary to design the control elements about which the panel will be constructed.

Fig. 18 shows one of the components—a compact indicating controller, occupying a panel space of approximately 9 by 12 inches. And yet, the pneumatic control element, the heart of the controller, is the same unit that has been used widely for years in conventional recording controllers. Actually, when we compare this instrument with a conventional model, all we have lost in gaining so much space is the record.

The controller shown schematically in Fig. 19 operates in conjunction with a non-indicating transmitter mounted adjacent to the process and a conventional air operated diaphragm motor valve. Flow readings are transmitted to the compact indicating controller (C.I.C.) unit which, in turn, controls the valve. Appropriate dials on the controller indicate: (1) control set point and value of the process variable; (2) controlled air pressure to valve when process is on automatic control, and (3) air pressure to valve when process is on manual control. Incorporated in the base of the controller are means for: Adjusting the set point, switching the unit to automatic, service, test, or manual position, and regulating the valve manually. Adjustments to proportional band and reset rate can readily be made at the rear of the controller.

Fig. 20 illustrates another device

*Presented at the thirty-eighth annual meeting of the Western Petroleum Refiners Association, San Antonio, Texas, March 27-29, 1950.

†Manager of Market Extension, Industrial Division, Minneapolis-Honeywell Regulator Company, Philadelphia, Pennsylvania.

FIG. 18. Compact-indicating-controller (C-I-C) showing symbol on nameplate, which identifies controller with point of application on flow diagram.

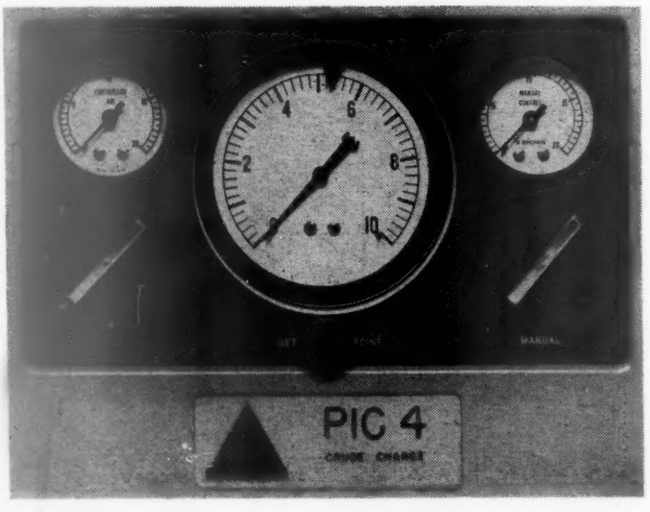
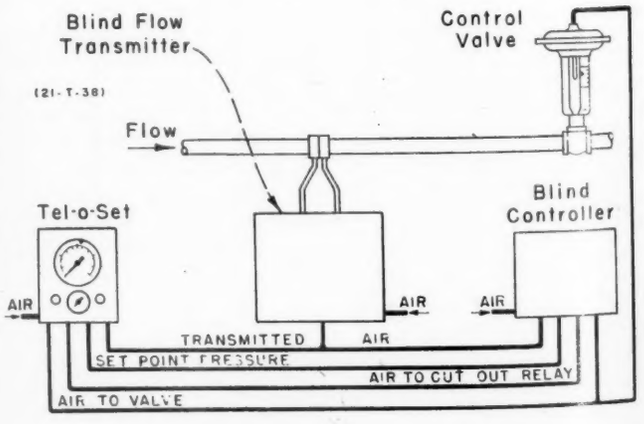


FIG. 19. Locally mounted non-indicating flow transmitter and panel-mounted compact-indicating-controller.



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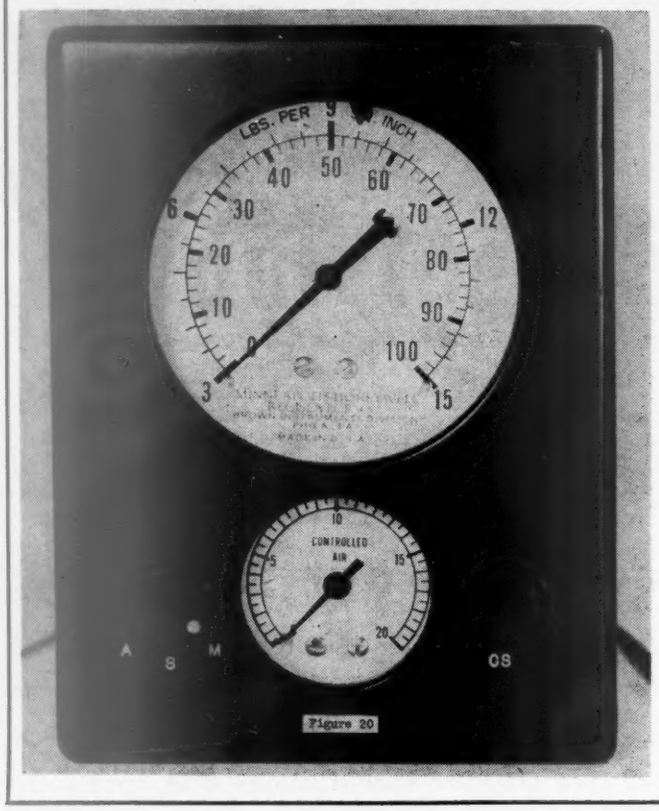
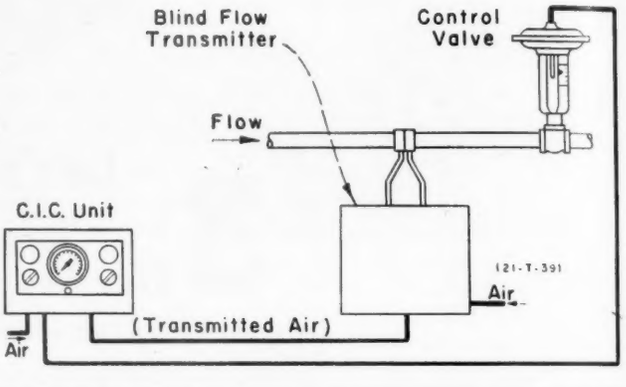


FIG. 20. Left, Tel-o-Set unit for Grafic panel use. Can be equipped with snap-on frame for use on Color-Grafic panel.

FIG. 21. Locally mounted non-indicating flow transmitter and non-indicating controller (locally or panel-mounted), operating in conjunction with panel-mounted Tel-o-Set unit.



designed specifically for graphic panel use. Occupying a panel space of only 5 by 6½ inches, this unit supplies indication of: (1) the controller set point, (2) the process variable, and (3) air-to-valve pressure on either manual or automatic control. Convenient knobs provide means for: (1) switching from manual to automatic control, (2) adjusting the controller set point, and (3) operating the valve when the process is on manual control.

In the case shown in Fig. 21 operation is in conjunction with a non-indicating transmitter adjacent to the process, a non-indicating controller which can either be mounted near the process or on the back of the control board, and the usual diaphragm motor valve.

Here again, standard components are used. The pneumatic transmitter element in this unit which enables the operator to adjust the set point index of a remotely located controller is standard in coventional pneumatic transmitters. By using standard proven components, the plant maintenance department is faced with no radically new problems.

The problem of designing the panel proper, i.e. the flow diagram and the manner in which the controllers are tied in with the diagram, differs radically from that of designing the control equipment proper, since it involves the efficient use of color, arrangement, and symbols. It is in essence, a problem for a top-flight industrial designer. Shown in Fig. 22 is a partial view of a *Color-Grafic* panel designed by the Henry Dreyfuss organization. It is the result of much research and experimentation involving the use of color, arrangement, and form, with a view to obtaining the greatest possible number of operator benefits. Among these benefits are:

Since, on this panel, all controllers are mounted directly below rather than on the pictorial flow diagram, a sizable reduction in board length is made possible. As an example, an installation using conventional instruments required a panel 45 ft long when the instruments were mounted two-high on 24-in. wide panel sections. Using a *Color-Grafic* panel for the same application, the over-all length was reduced to 22½ ft. Included in this length were two 3½-ft wing extensions to accommodate potentiometer controllers, recorders, and service gauges. Since the arrangement of the panel is such that recorders (either strip or circular chart) can be mounted directly in the main panel, below the banks of compact indicating controller units, it is possible to eliminate one of the extension wings, thus reducing the over-all panel length to 19 ft. This affords a saving of 26 ft over the conventional panel originally described.

Several factors combine to permit this sizable reduction in length. All of the compact indicating controllers are mounted below rather than directly in the flow diagram. This, of course, makes possible a flow diagram constructed to a relatively small scale. Gauges shown directly in the processing units and flow lines indicate liquid level and other variables which are not controlled from the panel. Additional gauges can be added to the flow diagram to supply indications of variables also shown on the compact indicating controller units. Air lines to these gauges are tapped into the transmitted air lines going to the compact indicating controller units. The large amount of panel space below the banks of controllers can be used for mounting recorders and remote valve operating stations.

Since the pictorial flow diagram need support no appreciable weight, it can be fabricated of some relatively light material such as plymetal or pressed wood. Process units and flow lines can be painted directly on the panel or made to stand out from the panel. All colors used on the panel are standard and consequently changes in process flow lines can easily be made by mill personnel.

The design of that portion of the panel below the pictorial flow diagram is essentially that of a relay rack with cover plates over unused portions. Compact indicating controller units can be used in single, double, or triple banks. When multiple banks are used,

the lowest bank usually is at least 30 in. above the floor. It is unnecessary to cut new openings or cover old ones in the flow diagram when the application of a controller is changed. If a controller is shifted from one application to another, it is only necessary to change the small instrument designation or symbol on the flow diagram. When a controller is removed completely from the process, the corresponding compact indicating controller unit is pulled from the controller panel and a cover plate is added to the unused portion of the panel.

Skillful use of color is a major factor in achieving ease of operation, and relies for its effectiveness on the proven fact that the human eye learns to detect color variations long before it can distinguish numbers and letters. A neutral background color is employed because it tends to make the colored flow lines and instrument designations stand out properly. Selection of gray combinations for various flow lines assures adequate visibility without causing interference with the points of instrument application. Piping, process units, valves, and other auxiliaries are grouped on the flow diagram in a manner which permits maximum ease of visual inspection.

The compact indicating controllers are located at a convenient height for both visual inspection and manual operation. Identification of a controller with respect to its point of application on the flow diagram is accomplished by means of color. Identification of the variable under control is effected by the form of a symbol. For example, a circle will indicate flow; a triangle, temperature; and a square, pressure. The color of this symbol identifies the point of application. A dark red triangle at some point on the flow diagram indicates that temperature is being controlled at that point. An identical red triangle on the nameplate of one of the compact indicating controller units quickly shows which unit is controller of the temperature at this point.

A total of ten colors is used here. These colors are arranged to give the greatest variation between adjacent units, and to avoid any visual conflicts. When more than ten controllers are used (which is commonly the case with a graphic panel), this entire color range is repeated over again. Filler panels in the controller bank separate groups of compact indicating controller units to prevent any possibility of visual conflict. Corresponding units on the flow diagram are similarly grouped with adequate spacing between adjacent groups.

Since the cost of instrument maintenance is an important factor on a large panel of any type, this factor received careful consideration in the early stages of design. For example, proportional ban and reset rate adjustments on the compact indicating controller units are easily accessible from the back of the panel. Where process conditions permit the use of the panel-mounted compact indicating controller units, only two air lines in addition to the air supply to the controller need be run; one to the locally mounted transmitter, and one to the valve.

A second type of graphic panel is shown in Fig. 23. This panel was designed for those users who prefer to mount the instrument directly in the flow diagram. It meets the requirements for having on the flow diagram compact units which: (1) continuously indicate the process variable, (2) provide means for adjusting the set point of a remotely located controller, and (3) enable operation of any unit under manual control. These units can be employed in conjunction with non-indicating controllers of either the back-of-board or locally mounted type.

Since, on this type of graphic panel, all instruments must be mounted directly in the flow diagram, this diagram must of necessity be constructed on a materially larger scale than that of the *Color-Grafic* panel previously shown. Consequently, extension wings must be provided to accommodate recorders. Referring again to the previously mentioned conventional panel

FIG. 22. Section of Color-Grafic panel showing bank of 8 compact-indicating-controllers mounted below flow diagram. Gauges mounted in flow diagram indicate liquid levels, and process variables not controlled from panel.

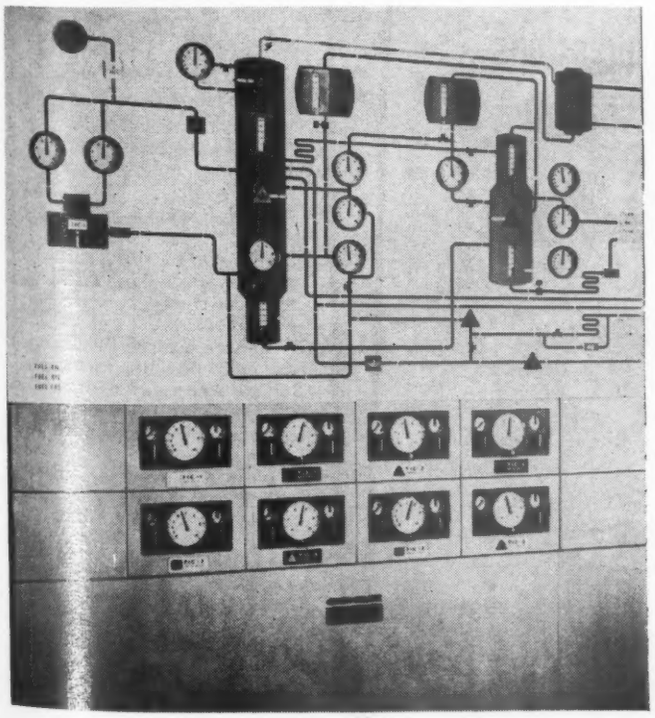
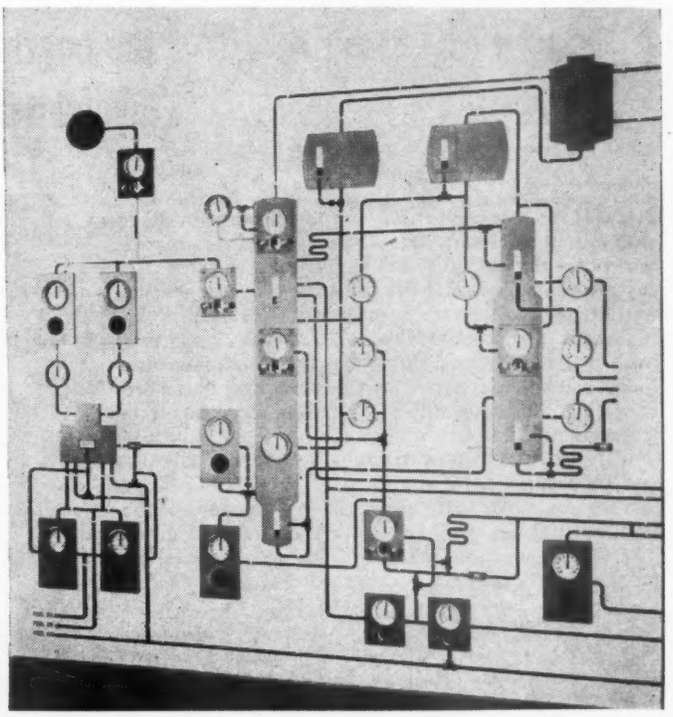


FIG. 23. Section of Grafic panel showing Tel-o-Set units and manual loading stations mounted directly on process units and flow lines.



45 ft long with instruments mounted two-high on 24-in. wide panel sections conversion to a graphic panel of this type would reduce the over-all length to 24½ ft. While this affords a material saving over the original 45 ft, it does not equal the 19 ft length made possible by the *Color-Grafic* panel.

Since the pictorial flow diagram shown here must support the weight of all indicating and controlling instruments, this panel must be fabricated of fairly heavy material, such as cold rolled sheet steel. Flow lines can either be painted on the panel or made to stand out above its surface. Any changes to a completed panel would necessitate working with sheet steel, covering up holes where instruments are removed, and cutting and drilling new holes for additional control units. Obviously, the flexibility of this type of graphic panel, as to changes in processes or flow lines, is limited. Process engineers must be extremely careful in laying out such a panel to keep future changes to a minimum.

Towers and associated equipment can be supplied either painted on the panel or standing out from the surface, and are carefully grouped for safe and efficient operation. Flow lines can either be painted or made to stand out from the surface, the colors clearly indicating the nature of the flowing medium. Utility lines, for example, can be red. Color is used to emphasize product flow lines, the colors in many cases approximating the actual shade of the flowing liquids. Heavy materials, such as charges and bottoms, are in general indicated by dark colors; lighter products are shown by piping of correspondingly lighter colors.

Some cost comparisons of the various types of graphic panels with the conventional panel for a given job may be of interest to you. For a recent fluid catalytic cracking project, the relative panel board costs were estimated as follows:

Cost of Conventional Panel....$14,562
Cost of Color-Grafic Panel.....$20,029
or 37% over the conventional
Cost of Grafic Panel.....$24,173
or 40% over the conventional

Although the relative percentage differences for these two jobs are not exactly the same—and, of course, that could not be expected since these panels are specifically tailored to a given job—you will note that in each case, the graphic type panels were considerably higher in cost than the conventional type panel.

Insofar as relative space economy is concerned, the following figures may be of interest.

For one specific job, a conventional panel was estimated to occupy 45 linear feet. The Grafic panel, 21½ ft; and the Color-Grafic panel 22[illegible] ft.

There has been considerable comment with the industry concerning savings in cost which can be effected by reducing space requirements through the use of graphic panels. On one job it was estimated that a control house 55 ft long, 20 ft wide, and 13 ft high would be required to house a 45-ft conventional panel needed for this job. This building was to have a pitched roof, brick walls, metal doors and sash, included heating fixtures, and would be of the same fireproof construction normally used in the petroleum industry. Cost of the building was estimated at $8500. Were a graphic panel to be used on this job, the building dimensions could be reduced to 30 ft in length with the width and height the same, at a construction cost of $6500. Thus the saving in building cost brought about by the use of the graphic panel was estimated at $2000. However, it was estimated that the graphic panel would cost $8600 more than the conventional panel; therefore, it is questionable whether space saving strictly from a cost standpoint is an effective argument in favor of the graphic panel. * * *

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NEWS

Phillips Chemical Forms Rubber Reserve Division

The Reconstruction Finance Corporation, Office of Rubber Reserve, recently announced that Phillips Chemical Company would take over operations of the Government-owned synthetic rubber plant, near Borger, Texas. Phillips Chemical Company already operates the adjoining Plains butadiene plant, which Phillips designed and built for the Government during World War II. Butadiene is the principal ingredient of synthetic rubber. This plant now produces more than 50,000 tons of butadiene yearly.

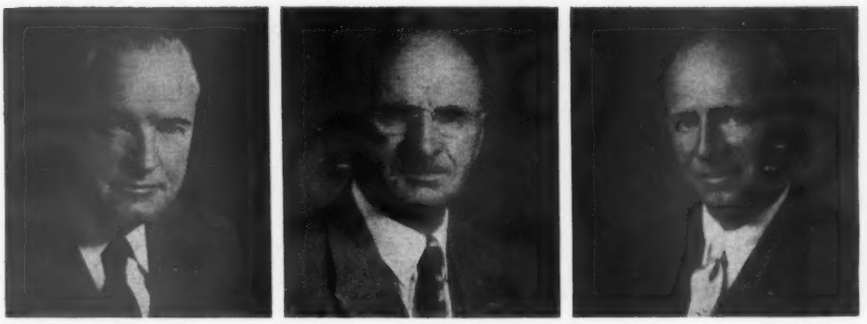
K. S. Adams, president of Phillips Petroleum Company and of its chemical subsidiary, announced that because of the consolidation of the two plants, a rubber division of Phillips Chemical Company has been formed. The key men supervising both plants are: W. C. Hewitt, plant manager; Austin Morgan, services superintendent; G. H. Short, manufacturing superintendent; and L. M. Fairman, industrial relations superintendent.

Hewitt has 15 years service with Phillips. Morgan, a 20-year man with Phillips, was recently transferred to Plains plant from Phillips Chemical Company's cactus anhydrous ammonia plant at Etter, Texas, where he served as assistant plant superintendent. G. H. Short has been with Phillips since 1935, and has served in the research department. Prior to his transfer he was assistant supervisor, chemicals and rubber branch, research division. L. M. Fairman was employed by Phillips in 1930, and has had wide experience as an operator, chemist, office manager, personnel director, and manager of community facilities.

Carbon Black Plant Planned for Louisiana

Continental Oil Black Company will erect a $1,500,000 plant at Lake Charles, Louisiana, designed to manufacture 25,000,000 lb annually of high abrasion carbon black from oil. Organization of the new company was announced by R. I. Wishnick, president of Continental Oil Company, whose companies are joint owners of the new enterprise. The announcement followed action by the Louisiana board of commerce and industry in approving a 10-year tax exemption for the new plant.

Contracts for the Lake Charles carbon black plant have been signed, and construction will start immediately. Operation of the plant, which is to be situated just west and adjacent to Continental Oil Company's Lake Charles refinery, is scheduled for early in 1951. Raw material for the new plant will be piped directly from Continental's refinery.



CNGA Meeting. California Natural Gasoline Association will meet November 9 and 10 in Los Angeles, for its Silver Anniversary. (For program see Page A-55.) Above left is the CNGA president, R. S. Tulin, Shell Oil Company; vice president, George C. McLaren, Standard of California, and chairman of the management luncheon, William A. Kirk, California Southern Oil Company.

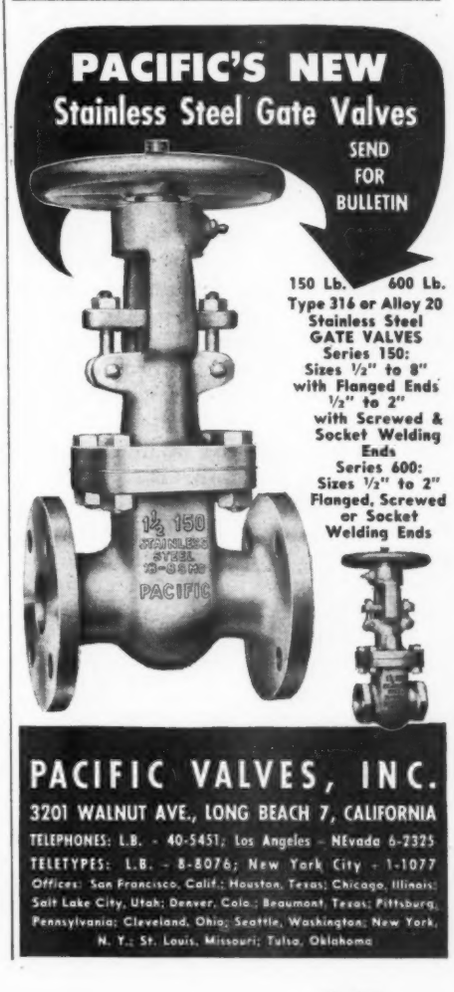
Chairman of the CNGA forums are: J. B. Taylor, Signal Oil and Gas Company, Forum No. 1; C. D. Gard, Union Oil Company of California, Forum No. 2; W. W. Robinson, Jr., The Texas Company, Forum No. 3; M. W. Kibre, General Petroleum Corporation, Forum No. 4. Forum programs are on page A-55.

Plant Site Changed

American Cyanamid Company announces that its new $3,000,000 plant for the production of cracking catalysts used by the petroleum industry, originally scheduled for construction in East Chicago, Indiana, will now be built in Michigan City, Indiana. Although a site was purchased in East Chicago, requirements for additional production capacity for a number of the company's products, have made it necessary for the company to change its plans and build the plant on a large site in Michigan City.

Refinery Closed In Former Oil Capital

The former Cities Service Oil Company refinery in Titusville, Pennsylvania was closed recently, marking an end to petroleum refining in what was long known as the Oil Capital of the World. The world's first refinery designed exclusively to process crude oil was established in Titusville in 1860. The refinery was purchased by Quaker State Oil Corporation from Cities Service just a few months ago.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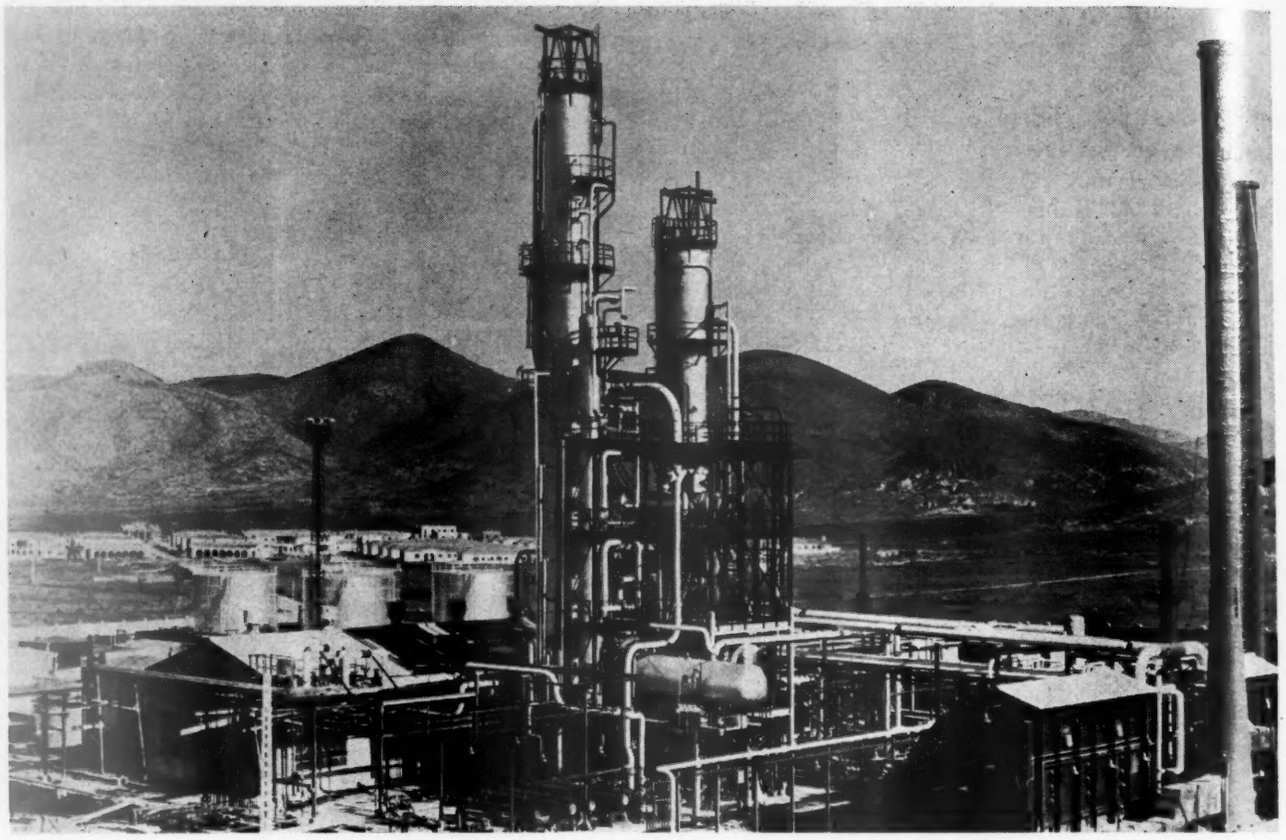

Two-stage distillation unit, Cartagena refinery, Spain.

Spanish Refinery to Be Expanded

Refinery capacity of the Caltex affiliate in Spain will soon be increased by possibly 50 per cent over the previous planned 20,000 bbl per day, W. F. Bramstedt, president of the California Texas Oil Company has announced. It marks the second time this year that an increase has been decided in the Cartagena operation.

Bramstedt said that a resurvey of Spain's future petroleum products needs had prompted the move to expand facilities at the Refineria de Petroleos de Escombreras, S. A. (REPESA) in which Caltex holds a 24 per cent interest. REPESA, whose principal ownership lies in the hands of a Spanish government agency, Institute Nacional de Industria, was organized in June 1949.

"On January 15, 1950, it was put into operation charging 5000 bbl a day of crude and producing motor gasoline, kerosine, diesel gas oil and fuel oil for consumption in Spain," Bramstedt said.

"Shortly afterwards, it was decided to expand to 20,000 bbl a day," he continued. "Anticipated date for completion of the new facilities was around April 1952. Now it appears necessary, however, to expand even further. Although the amount has not been set, it will be around 50 per cent more."

REPESA president Jose M. De Lapuerta has already estimated that Spain would save around $8,000,000 annually in foreign exchange normally spent for imported petroleum products, now coming from the Escombreras refinery.

Facilities already planned within the next 18 months include an atmospheric distillation unit, a thermal reformer, a catalytic polymer plant and complete facilities for the manufacture of automotive and industrial lubricants. The lubricating oil plant, in the discussion stage at present, would call for a yearly capacity of 20,000 tons of products.

The crude distillation unit will have a gasoline rerun column and stabilization. Designed to handle over 20,000 bbl a day, the overhead gasoline from the two crude units will be rerun into light and heavy gasoline with the light fraction later being stabilized. A reformer unit will be designed to improve the octane number and volatility of the heavy straight run gasoline. It will have clay facilities to treat the reformed product assuring a color for the product of water whiteness. The recovery of C-3 and C-4 olefins for feed to the catalytic polymerization unit and stripping the residue to improve gasoline fractions will be provided for. It will handle 6000 bbl daily when reforming 210/400 F heavy gasoline to produce the debutanized 400 F endpoint gasoline. This will have a clear octane number of 70(ASTM F-2). * * *

W. F. Bramstedt, president, California Texas Oil Company

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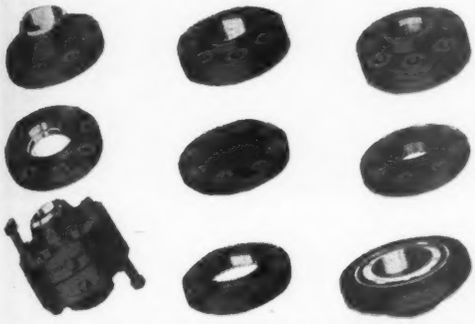

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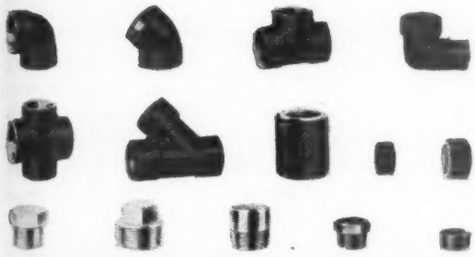
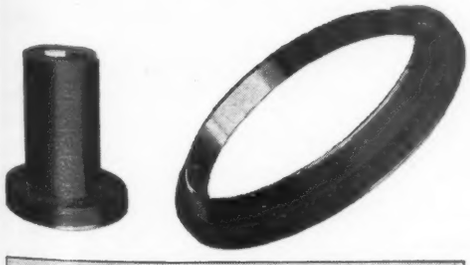


FORGED STEEL FITTINGS

Screwed and Socket Welding
⅛-inch through 4 inches
2000 lbs. through 6000 lbs. pressure



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Cities Service Terminal and Compound Plant Opened

Cities Service Oil Company's new compound plant at Chicago, Illinois is designed to compound, blend, package and ship 25,000,000 gal of lubricating oil annually. The main building is 450 ft long by 140 ft wide, has a full basement, and varies in height from one to four stories. Outside tankage used for the storage of base stocks and additives consists of 42 units of from 10,500 gal to 420,000 gal capacity. Total capacity of all tanks is 7,000,000 gal. Each of these tanks is equipped with a suction heater and an individual suction line to the transfer pump room. Oil in the tanks is protected against contamination by condensed moisture by a blanket of fan-forced air dried by passage through beds of activated alumina.

Base oils used are produced by the Cit-Con refinery at Lake Charles, Louisiana, and are transported to the plant by barge. A two-barge tow is used for this transportation and approximately 3 weeks is required for the round trip of 3200 miles. The barges used were especially designed for this job and are approximately 245 ft long, 50 ft wide, 10 ft deep, and draw approximately 8 ft of water when loaded. Each barge has 8 compartments and handles 670,000 gal of lubricating oil stock.

Laboratory at Cities Service Chicago terminal and compound plant. Blended oil is tested and certified before release.

The main unloading units are two 18-in. by 14-in. by 18-in. duplex reciprocating steam pumps; a 7½-in. by 6-in. by 10-in. pump is also available for priming purposes if conditions should require its use. A novel feature of the barge unloading equipment is a heat exchanger through which a portion of the discharge stream can be diverted, heated and returned to the barge for the purpose of raising the temperature of the oil. This exchanger uses discharge steam from the pumps and is intended to be used only when oil in the barge is highly viscous as a result of low temperature. The discharge system from this pump installation to the storage tanks consists of one 10-in., two 8-in. and two 6-in. lines. Provision was made on these lines for the use of "pigs" for purging the lines to avoid any mixing of oils in the lines.

Two five-meter proportioner systems with homogenizers are used for the continuous blending of lubricating oils. Each of these systems has a rated capacity of 125 gpm at maximium viscosity of 1200 SSU. Situated in the top portion of the building are 52 vertical shop-built tanks, varying in capacity from 4200 gal to 12,600 gal, total volume being 378,000 gal. All of these tanks are equipped with fin-tube coils for heating; five 4200 gal and four 12,600 gal units have permanently installed mixers and can be used for blending if desired.

Refinery Runs Exceed 200,000 Bbl Per Day

The Whiting, Indiana, refinery of Standard Oil Company (Indiana) has for the first time exceeded 200,000 bbl per day in its average runs of crude oil, the company announced. Figures compiled for August show that the refinery processed 200,764 bbl per day of crude oil and natural gas liquids, This was 5515 bbl per day more than the previous high mark reached earlier in the year.

The new Whiting record was motivated by two conditions, the company said. One was making available high-octane gasoline for the armed forces. The other was that an expanded market for home heating oils required that inventories be increased for winter.

Construct Ontario Plant

Canadian Oil Refineries, Ltd. has announced plans for building an $18,000,000 refinery at Froomfield, Ontario to process Alberta crude oil. A subsidiary of Canadian Oil Companies, Ltd., a company spokesman announced that Stone and Webster Engineering Corporation will construct the plant, which has an approximate opening date of April 1952.

The refinery will produce an annual 105,000,000 gal of gasoline as well as diesel, stove, furnace, and heavy fuel oils. In the event of a national emergency, the plant layout permits installation of equipment for production of aviation gasoline and synthetic rubber components.

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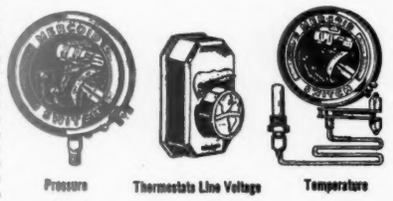

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Airlines Oppose Fuel Change

The airlines have informed the Defense Petroleum Administration that proposed changes in aviation gasoline specifications may reduce flying safety and affect the lines' capacity to help national defense. The new agency formed by the Interior Department to seek new methods of averting a threatened shortage of military aviation fuel, has been told by the Air Transport Association that the proposed changes would:

Increase the over-all possibilities of major and potentially fatal airplane accidents.

Seriously reduce commercial airline airlift capacity for national defense.

Increase airline fuel consumption by about 15 per cent, to assimilate higher lead content and lower volatility.

Carter Sells Refinery to Berry

Carter Oil Company recently sold its Cut Bank, Montana, refinery to W. C. Berry, independent operator of Tulsa, Oklahoma. Operations were shut down October 1. The Carter plant has a crude capacity of 3500 bbl per day and has been running at that rate on northern Montana crude. It is reported that Berry plans to dismantle the plant and move it to Superior, Wisconsin where it will operate on Canadian crude to come via the new pipe line.

Phillips Will Begin Producing Carbon Black

Phillips Chemical Company will soon begin construction of an additional plant for the production of Philblack O, the pioneer HAF (high abrasion furnace) carbon black, according to an announcement made by K. S. Adams, president of the company and of its parent company, Phillips Petroleum Company. The plant will be built adjacent to the present Philblack A and Philblack O plants in the vicinity of Borger, Texas, and completion is set for late 1951.

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AN ECONOMY FACTOR IN REFINERY OPERATION

Proved long life and stubborn resistance to corrosion make cast iron pipe a contributing factor in lowering plant maintenance per barrel of crude. Replacing shorter-lived pipe with cast iron pipe has demonstrated this in many refineries. Cost per term of service decreases. Interference with production, caused by frequent replacements, ceases to be a headache. Cast iron pipe works hand-in-glove with plant management to keep maintenance cost down in many refinery operations. Available with bell-and-spigot, plain end and flanged, or with standardized mechanical joints. Cast Iron Pipe Research Association, Thomas F. Wolfe, Engineer, 1015 Peoples Gas Bldg., Chicago 3, Illinois.

CAST IRON PIPE
FOR LONG LIFE AND ECONOMY

—PERSONALS—

▸ **Dr. Louis Schmerling,** a research chemist with Universal Oil Products Company, Chicago, Illinois has been selected as the recipient of the 1951 Precision Scientific Company award in petroleum chemistry. The $1000 cash prize, which is administered by the American Chemical Society, was created to recognize, encourage, and stimulate outstanding research achievements in the field of petroleum chemistry in the United States and Canada. The award presentation will be made during the national meeting of the A.C.S. in April 1951.

Among Dr. Schmerling's accomplishments is the clarification of the mechanism of alkylation of isoparaffins—a process that was widely used during World War II for the manufacture of high octane aviation gasoline. He has written about 30 scientific publications and holds 70 U.S. patents dealing with the manufacture of gasoline and chemicals from petroleum. In 1947 Dr. Schmerling was selected as the first winner of the triennial $3,000 Ipatieff prize in chemistry for his outstanding experimental work in the field of catalysis.

Dr. Schmerling, 38, was born in Milwaukee, Wisconsin and received his early education in the schools of that city. He was granted his Bachelor of Science in chemistry from the University of Wisconsin in 1932 and his Ph.D. from Northwestern University in 1935. Since leaving school he has been associated with Universal, engaged in the field of chemical research.

▸ **R. O. Traylor,** superintendent of the industrial relations division at the Whiting, Indiana, refinery of Standard Oil Company (Indiana), has been promoted to become an additional assistant director of industrial relations in the general office at Chicago. **F. Roe Weise** will continue as the other assistant director of industrial relations in the general office. **J. P. Nielsen,** supervisor of labor and personnel in the general office industrial relations department, will be advanced to superintendent of the industrial relations division at the Whiting refinery to succeed Traylor.

Traylor joined Standard in 1922 as a clerk in the employment bureau at the Casper, Wyoming, refinery, where he became supervisor of safety. After transferring to the Neodesha, Kansas, refinery as supervisor of safety and labor relations in 1938, he was made assistant supervisor of labor relations at the Whiting refinery in 1942. At Whiting he became assistant to the general superintendent of the refinery in 1945 and superintendent of the industrial relations division in 1948.

Nielsen joined the company in 1917 as a timekeeper at the Whiting refinery. After advancing to head timekeeper, assistant to the office manager, and assistant office manager at Whiting, he became office manager at the Sugar Creek, Missouri, refinery.

▸ **E. E. Thompson** was recently named vice president in charge of refining for Mid-West Refineries, Inc. **R. J. Oosdyke** was named vice president in charge of sales, and **J. D. MacLeish,** was made secretary and treasurer.

▸ **E. E. Boudinot,** veteran construction engineer for General Petroleum Corporation, Los Angeles, California has been selected to supervise the construction of a new $30,000,000 oil refinery to be built by the Vacuum Oil Company, Ltd., in Coryton, England. Both General Petroleum and the Vacuum Oil Company, Ltd., are affiliates of Socony-Vacuum Oil Company, Inc. The project will take about 30 months to complete.

With General Petroleum since 1917, Boudinot has played an important role in the construction and growth of General Petroleum's modern refinery at Torrance, California. The new Coryton refinery will treat Middle East crude oil primarily and will have a capacity of approximately 20,000 bbl of crude oil daily. It will specialize in the production of high grade lubricating oils. It is expected that the new refinery will aid Britain's efforts to reduce its dollar deficit.

▸ **Don V. Eells** of Ponca City, Oklahoma, has been appointed manager of the new terminal and compound plant of Cities Service Oil Company (Delaware) at Chicago, Illinois. **S. R. McMurry,** formerly foreman of cracking operations at the company's East Chicago, Indiana, refinery, has been named to succeed Eells at Ponca City. Eells is a long-time Cities Service employee, having joined the company in 1917. He was on the refining division staff of Cities Service at Tulsa for 5 years, transferring to Ponca City in 1925 as assistant superintendent. He was superintendent of the Cities Service refinery at Okmulgee, Oklahoma, from 1927 to 1938.

McMurry was first employed by the company at Gainesville, Texas, in 1924. After serving as a junior engineer, he worked in various capacities in connection with operation of pressure stills at the Gainesville refinery and later at the East Chicago refinery

▸ **W. Graham Jamison** has been elected vice president of Catalytic Construction Company. He will continue as company treasurer, a post he has held since the company's formation. Jamison was formerly assistant to the controller of Sun Oil Company. He is a graduate of the Wharton School, University of Pennsylvania.

▸ **Frank T. Page** was named manager of the New York export sales office of Phillips Chemical Company's fertilizer sales division. Page, a native of Pittsburgh, Pennsylvania, attended Duquesne University and is a graduate of University of Illinois.

▸ **Frank C. Fahnestock,** technical advisor since 1948 to the chief engineer, refinery engineering division, of the Socony-Vacuum Oil Company, Inc., has been appointed coordinator of foreign refining in the company's manufacturing department at 26 Broadway, New York. Fahnestock, graduate of the Massachusetts Institute of Technology in 1931, began with Socony-Vacuum as a student engineer and held various operating jobs at the Paulsboro, New Jersey, refinery until 1939, when he was transferred to the refinery engineering division. He was the United States member of the Allied Oil Working Party for Western Germany from March to May, 1949, and ECA consultant on oil for Western Germany from March to May of 1950.

Products Pipe Line Conference

SOMETHING new was tried this year by the American Petroleum Institute's Division of Transportation. A Products Pipe Line Technology Conference was held in St. Louis, Missouri, during September, being sponsored by the subcommittee on products pipe line technology of API. The conference, ably presided over by John W. deGroot, president of Tuscarora Oil Company, Ltd., was organized under the Institute's Division of Transportation, Committee on Pipe Line Technology, headed by H. H. Anderson, vice president and general manager of Shell Pipe Line Corporation. The conference was something of a test run, so to speak, the thought behind it being to give products pipe line men an opportunity to discuss among themselves their own particular problems. That the idea met with approval was borne out by the number that attended, the outstanding program presented, and the fact that full attendance was maintained at the technical sessions right through the final one.

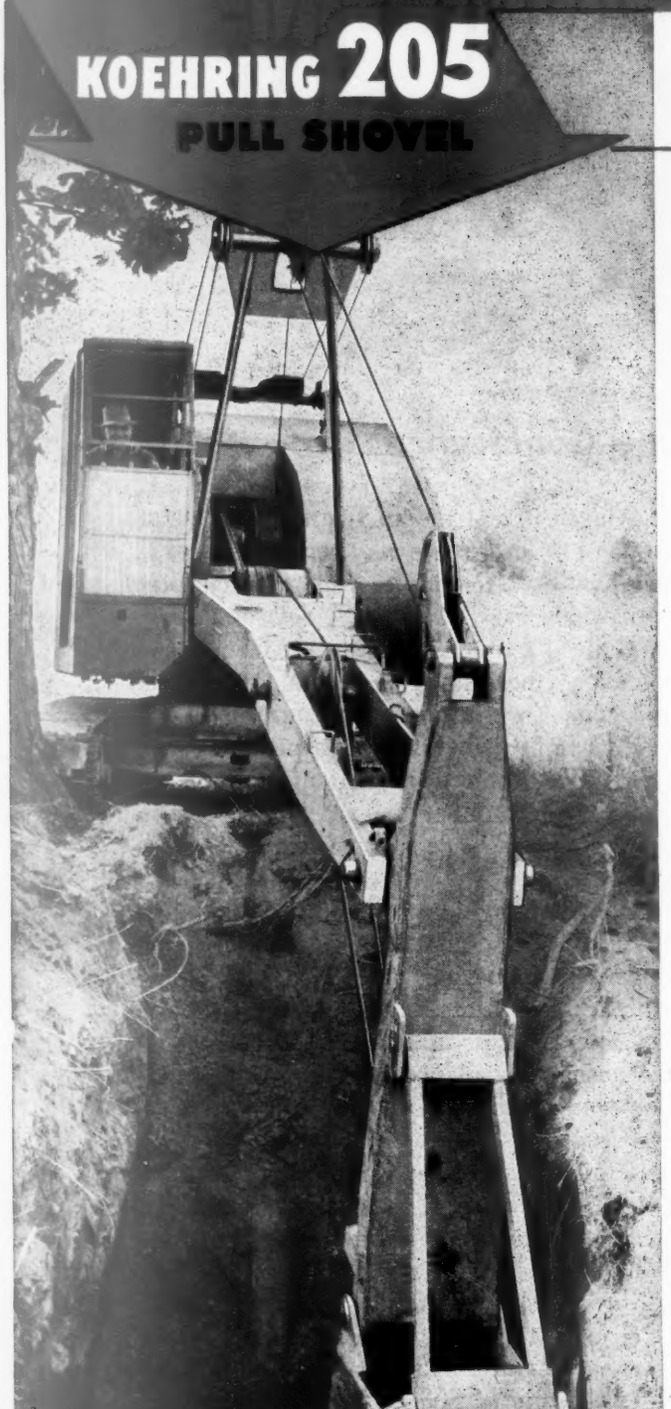
A wide sweep of subjects was covered during the three-day conference. Included were automatic stations of the fully automatic, semi-automatic, and remotely controlled type, use of microwave in communications, metering practices, design, hydraulics, operational costs, inhibitors, mechanical pump seals, maintenance of mobile transportation equipment, and repairing leaks. A forum type meeting, at which a panel of specialists answered questions submitted by those in attendance, completed the group sessions. In addition, field trips were made to several Shell pump stations where some of the things discussed in the meetings were observed.

To those not in attendance the high caliber of the program can perhaps best be indicated by naming those who participated: H. E. Fisher and J. P. Hedlin of Standard Oil Company (Indiana), R. F. Hadley, John Jednacz, and C. Alan McCutcheon of Susquehanna Pipe Line Company, S. S. Smith and Norris Plank of Shell Oil Company, R. H. Lynch and E. B. Dunn of Keystone Pipe Line Company, Frank O. Stivers, Jr., of Humble Pipe Line Company, C. C. Keane of Great Lakes Pipe Line Company, F. M. Watkins and K. T. Feldman of Sinclair Refining Company, M. J. Dabney and W. W. Holt, Jr., of Plantation Pipe Line Company, T. L. Opie of Socony-Vacuum Oil Company, and G. T. Jennings of Phillips Petroleum Company. Panel members were L. S. Wrightsman, Humble Pipe Line Company; C. C. Keane; W. G. Hortsman, Plantation Pipe Line Company; D. C. Glass, Pure Oil Company; S. S. Smith; Ray Scott, Standard Oil Company (Indiana); L. A. Baxter and E. B. Dunn, Keystone Pipe Line Company.

A show of hands was asked by Chairman deGroot on whether this conference should be made an annual affair. The decision was unanimous. That also was our feeling.

J. H. Love

HERE'S A POWERFUL PAIR OF TRENCHERS



NO WEAVING with this rigid pull shovel front end

Extra strength, extra resistance to side-sway are built into the Koehring ½-yard 205 pull shovel. You get a straight, clean ditch in toughest oil field digging because this 205 pull shovel is mounted on a rugged heavy crowd shovel boom. Front end will not weave . . . dipper doesn't turn away from the cut, because broad, shovel-type boom point gives a wide connection to the rigid pull shovel dipper arm. Its long, deep digging reach (15'3" below tracks), powerful ½-yard bite, fast swing and easy dumping mean more feet of pipeline trench per day.

dual-purpose boom saves time and money

Because pull shovel and crowd shovel use the same boom, this Koehring 205 combination saves time when you convert from one attachment to the other . . . and costs 20 to 25% less than conventional units that require two separate booms. What's more, crowd and retract cable is self-contained in boom, stays intact when boom is removed . . . saves more time when changing to dragline, clamshell, lift crane or pile driver.

Koehring heavy-duty 205 further assures more production at lower costs because you have independent traction, to travel, swing and operate boom all at same time . . . self-adjusting main clutches for peak operating efficiency at all times . . . choice of crawler, rubber-tired cruiser or truck mounting to suit your exact needs.

Your local Koehring distributor is experienced in oil field problems . . . will analyze your trenching, excavating and other materials-handling requirements in the interests of greatest efficiency, production and savings for *you*. See him today about Koehring heavy-duty ½-yd. 205 . . . ¾-yd. 304 . . . 1½-yd. 605 . . . or big 2½-yd. 1005.

KOEHRING HEAVY DUTY

KOEHRING COMPANY • MILWAUKEE 10, WISCONSIN

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Coating and wrapping pipe on spread near Marshall, Texas.

P 615.3

Year's Longest Crude Oil Pipe Line

Mid-Valley Pipe Line Company's system completed and placed in operation well ahead of schedule—Construction details.

FRANK H. LOVE*

THE longest crude oil line to be laid in recent years, that of Mid-Valley Pipeline Company, has been put in full operation. Extending from Longview, Texas, to Lima, Ohio the overall mileage of pipe laid was 1020, including 933 miles of main line and 87 miles of spurs.

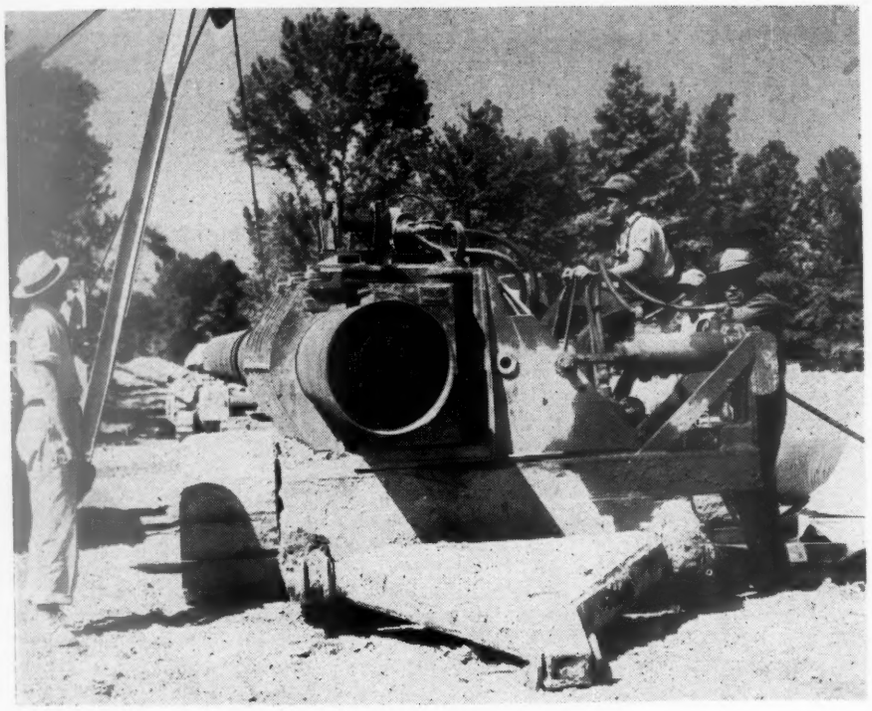
Begun in 1949, sections of the line were placed in operation as completed where this could be done, or the line filled awaiting straight-through pumping. The section of main line between Haynesville, Louisiana, and Mayersville, Mississippi, was finished in December of last year. This made it possible to pump crude from producing fields in the Haynesville area into tankage at Mayersville terminal from where it was barged up the Mississippi and Ohio Rivers to refinery destinations. The spur line from Delhi, Louisiana, to Mayersville was completed in June, adding to the crude supply available at the latter point for river shipment. In July, the section from the Ohio River into Lima, was finished. Final construction work was completed three weeks ahead of schedule despite excessive rains. With the exception of April, every month this year had rainfall greater than normal.

As has been published here and elsewhere, Mid-Valley is owned jointly by the Sun Oil Company and the Standard Oil Company of Ohio. Crude is being delivered to Sun's refinery at Toledo, Ohio, and to Sohio's refineries at Cleveland, Toledo, and Lima, Ohio, and Latonia, Kentucky. Direct deliveries are made from Mid-Valley to the refineries at Latonia and Lima. Others are served by Buckeye Pipe Line Company into which Mid-Valley makes deliveries at Lima.

The line is designed for an ultimate capacity of 235,000 bbl a day, but that capacity will not be attained until additional booster stations have been installed. As now operating, the capacity between Longview and Haynesville is 107,000 bbl a day at a discharge pressure at Longview station of 1030 psi. With additional crude taken at Haynesville, the capacity from that point to Mayersville is increased to 120,000 bbl a day, the discharge pressure at Haynesville station being 750 psi. From Mayersville to Hebron, Kentucky, the capacity is 157,000 bbl per day at a discharge pressure of 935 psi, and from Hebron to Lima, 143,000 bbl per day at a discharge of 1030 psi.

*Oil and Gas Pipelining Editor.

EXCLUSIVE



At left, making a smooth bend for the new Mid-Valley line.

Construction Details

After an aerial reconnaissance was made of the proposed route of the line, and a profile of the entire line prepared for hydraulic study, it was decided to use 3 weights of line pipe in a telescoping arrangement wherein at the hydraulic center of each section the telescoping was begun over again to allow for the future addition of booster stations. In this arrangement, a typical 22-in. section includes $\frac{11}{32}$-in. wall pipe weighing 79.51 lb per linear foot, $\frac{5}{16}$-in. pipe weighing 72.38 lb per foot, and $\frac{9}{32}$-in. pipe weighing 65.24 lb per foot. Pipe specifications required 52,000-psi minimum yield and the line design permits operating at a 1.75 safety factor.

Welding procedure called for the use of Fleetweld No. 532 rod for the stringer bead, No. 85 for the filler passes, and No. 5V for the cap weld. All stringer beads were hot passed. In the case of pipe having a wall thickness in excess of 0.300 in., the pipe was preheated before welding to 200 F when the atmospheric temperature was less than 75 F, and when the atmospheric temperature was below 40 F all pipe was preheated regardless of wall thickness.

The entire line was coated and wrapped, although there was some variation in the number and type of wrappers, depending on local conditions. The 22-in. pipe, which totaled 577 miles, was given a minimum of $\frac{3}{32}$-in. coating of coal tar enamel and a double wrap, one of glass and one of

Welding a section of pipe in Kentucky.

Clamshell cleaning out caved ditch in Tennessee.

Stringing truck hauling pipe into the right-of-way in heavily wooded area of Kentucky.

asbestos felt. Between Longview and Mayersville, the same minimum thickness of coal tar enamel was applied but only one wrap given. About half of the line between these two points was wrapped with glass and half with felt. From the Ohio River north to Lima, the pipe was coated to a thickness of $\frac{3}{32}$-in., and the first 22 miles double wrapped with glass and felt, the remainder being wrapped with glass for half the distance and with felt the other half. An exception was made to these specifications in swampy country, where the coating thickness was increased to $\frac{5}{32}$-in. and the pipe double wrapped. On all river crossings, the pipe was double coated and double wrapped, except in one instance, the Mississippi, where Somastic and concrete were applied.

As a further protection to the pipe numerous rock shields were used. This was particularly true in Kentucky where considerable rock was encountered that had to be blasted to make ditch. On some stretches there was no dirt whatever to be had for cover and rock shields were the only means of protecting the pipe coating from being penetrated by the rock backfill. In addition, rock shields were used on all railroad and road crossings even though the pipe was cased.

Two rectifier units have been installed at each pump station as permanent electrolysis test stations, and additional cathodic protection will be added to the system when needed.

River Crossings

Eight major rivers were crossed: The Red, Mississippi, Tennessee, Cumberland, Green, Barren, Kentucky, and Ohio. All were single line crossings except the Mississippi, and all were pulled except the latter. A 6-mile-an-hour current, the width of the river, and the fact that the Mississippi's bottom is constantly shifting, made this operation a difficult one and necessitated the adoption of special methods. The two 20-in. lines were laid from barges and were buried 15 ft below the maximum depth of the river bed. Another departure from usual practice was the bowing of one line upstream and the other downstream, with the shore ends of the pipe within a few feet of each other. The gap in midstream is 500 ft.

To dig the ditch for burying the pipe, a 10,000-hp suction dredge was used. The dredge was equipped with a large "egg beater" having a cutter that weighed 125 tons, which churned up the bottom of the river. The dredge's centrifugal pump removed an average of 50,000 cu yd of silt per 24-hr day, which was deposited through conveyor pipes 200 yd downstream and off channel.

The 20-in. pipe was laid in 120-ft sections from a barge on which had been constructed a slanting wooden ramp. After each section was welded onto the line extending from the shore into the river, it was lowered into the trench by cranes. The pipe was coated with Somastic plus 2 in. of reinforced concrete, each section weighing 33,000 lb.

As mentioned, the other 7 major river crossings were pulled. The preliminary ditch on all but the Red and Ohio was shot. Another exception was the Tennessee where the pipe was not buried due to the fact that it was laid in 50 ft of water and thus well below the danger point from river craft. In

W. C. Kinsolving, chairman of board, Mid-Valley Pipeline Company.

Edward F. Morrill, president and board member, Mid-Valley.

Charles R. Perkins, secretary and board member, Mid-Valley.

the case of the Red River the same procedure of burying the pipe deep as was followed on the Mississippi River crossing was adopted. The pipe, however, was not coated with Somastic or concrete. Cast-iron river weights and ½-in. wall pipe were used on all crossings.

A tabulation of major river crossings, width of the water crossing, and total width including approaches is given below:

River	Location	Water, feet	Total, feet
Green.....	Near Woodbury, Ky.....	270	600
Barren.....	Near Woodbury, Ky.....	250	450
Ohio.....	Near Delhi, Ohio.....	1200	1600
Mississippi...	Near Rolling Fork, Miss..	3100	9000
Tennessee....	Near Humphreys, Tenn..	1600	2000
Kentucky....	Near Locust Grove, Ky...	280	3500
Cumberland.	Near Clarksville, Tenn....	585	885
Red.....	Near Dixie, La.....	898	1772

Pumping Stations

Of the seven pumping stations, a part are electric motor driven, the rest powered by diesel engines. The Abbeville, Denver, and Mayersville stations are electric, the Longview and Haynesville stations dual fuel, and the Clarkson and Hebron stations straight diesel. Motors for the main line units are 1500-hp, 3600-rpm, 2300-volt. The main engines at Longview and Haynesville are 800-hp atmospheric dual fuel units and these can be supercharged to 1200 hp when ultimate capacity is required. Hebron and Clarkson have 1750-hp turbocharged engines.

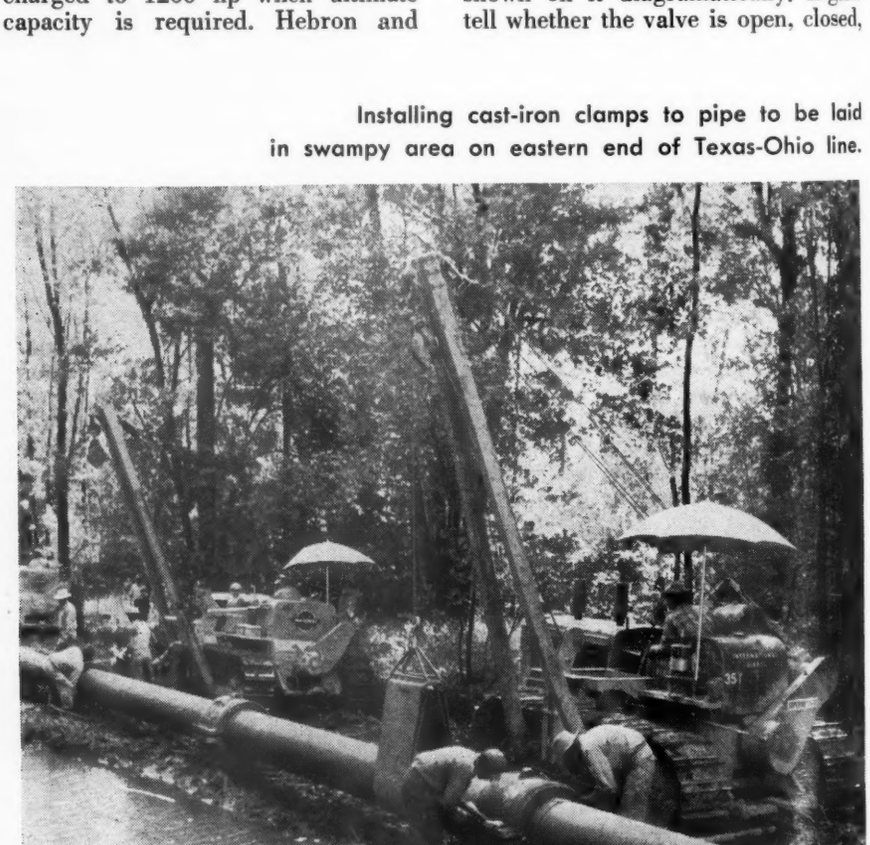
The pumps are 12-in., 2-stage centrifugals at Mayersville, Abbeville, Denver, Clarkson, and Hebron. Single-stage 12-in. pumps are installed at Longview and Haynesville. At the diesel stations, the pumps are connected to the prime movers through speed increasers. Some of these units are rated at 1200 hp and some at 1700 hp. All stations have a booster pump that is used to inject the required make-up into the main line stream and thus avoid slow down or throttle that otherwise would result because of the different types of crudes being pumped by the successive stations.

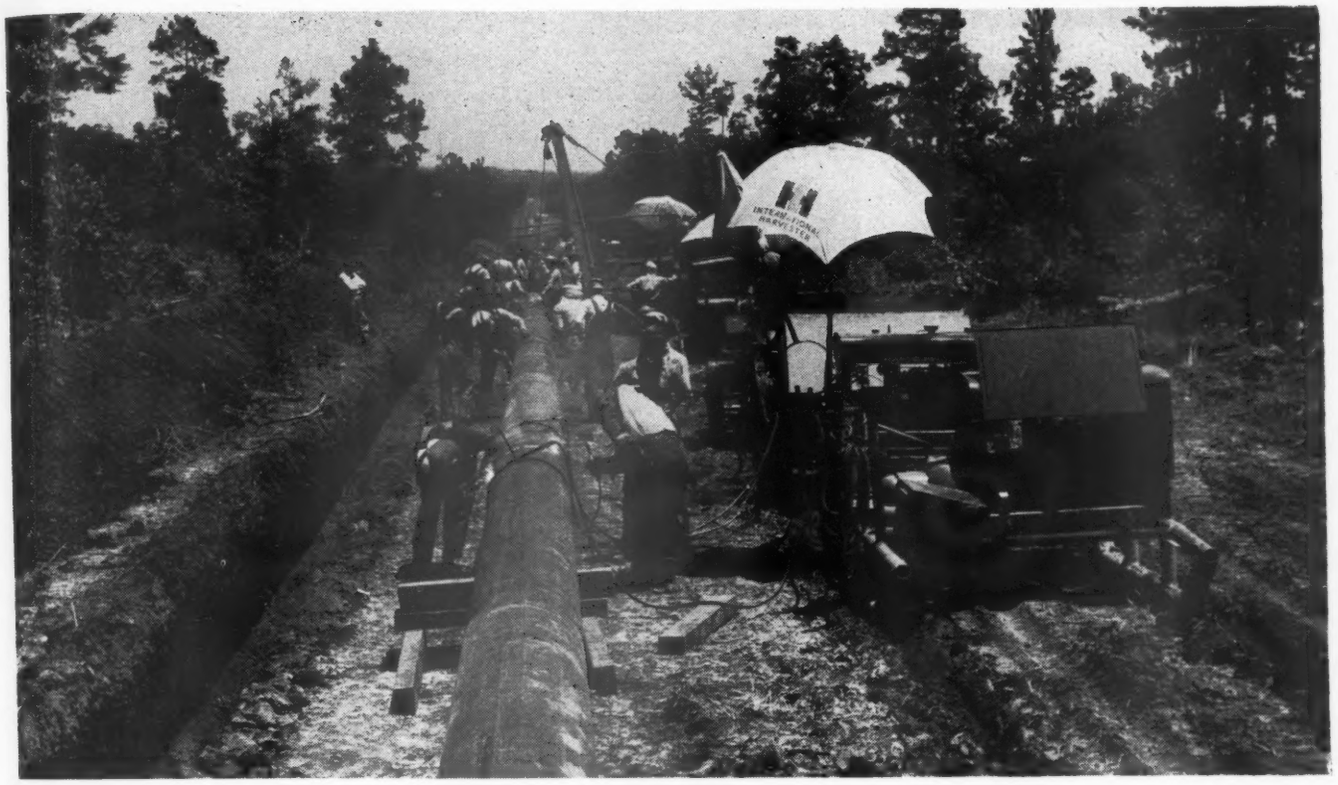
Each station is equipped with two pumping units and provision has been made for a third when ultimate capacity is desired.

The electric motors are base ventilated. Fans are mounted above the control room and ventilate the motors through ducts under the floor, the discharge being outside the station building.

The control room is elevated above the floor level of the engine and pump rooms, full view of these rooms being afforded the operator by a large separating window. The control desk is typical of other recent installations, station piping and all valves being shown on it diagramatically. Lights tell whether the valve is open, closed,

Installing cast-iron clamps to pipe to be laid in swampy area on eastern end of Texas-Ohio line.





Lining-up and tack welding on the spread near Marshall, Texas.

or in an intermediate position. Warning lights reveal any unusual conditions in the station operation.

Electric units can be started and the station put on the line from the control desk; however, in the case of the diesel stations, the engines are started at a control board in the engine room, the engine speed then being controlled from the control room.

Both types of stations have emergency shut down controls on the control desk. The pressure controllers, the flow meter, bearing temperature recorders, and pressure gages are mounted on each side of the control desk.

Tankage

The terminals have the following tankage: Longview, four 81,000-bbl tanks; Haynesville, three 81,000-bbl tanks; Delhi, three 81,000-bbl tanks; Mayersville, eleven 81,000-bbl tanks, and Hebron, three 81,000-bbl tanks. The stations at Abbeville, Denver, and Clarkson each have one 81,000-bbl tank to smooth out the flow pattern. Magnolia station has four 20,000-bbl tanks. All tanks have floating roofs.

Communications System

A microwave relay system, operating in the 6575-6875-mc band, provides telephone, teletype, and extension of mobile radio communications over the entire length of the line from Longview to Lima. Repeater stations have been spaced from 14 to 37 miles apart, depending on terrain. Each relay station includes a VHF remotely controlled transmitter and receiver unit for drop off communications between any relay or terminal point of the microwave system and any Mid-Valley 2-way radio-equipped mobile unit. Messages are carried along the microwave circuit to the relay station nearest the vehicle to which communications are directed, and then converted to the mobile frequency. Company vehicles thus use 2-way radio systems just as though they were communicating directly with a VHF central station. In addition to the circuit used for mobile communications, two circuits are assigned to party-line dial-telephone systems, three to private-line dial-telephone systems, and one to carry a party-line teleprinter.

This microwave relay system is the most extensive now in operation for pipe line service.

Canadian Line Completed

Canada's first major crude oil pipe line went into partial operation recently, less than 6 months after construction began on the 1127-mile Alberta-to-Great Lakes system. The line will carry Alberta crude to Superior, Wisconsin, where tankers will receive it for trans-shipment to refineries at Sarnia, Ontario. It is expected that by the end of November crude oil will be flowing through the next 336-mile section to Gretna, Manitoba.

Mid-Valley Personnel

Personnel of Mid-Valley Pipeline Company has been announced as follows:

Edward F. Morrill, president and member of the board of directors. He formerly was president of Sohio Pipe Line Company.

Charles R. Perkins, secretary-treasurer. He has been with the accounting division of Sun Oil Company for 25 years, his last post being in charge of the Evansville, Indiana, office.

Frank Males, chief accountant, has been with Sohio Petroleum Company at Oklahoma City, Oklahoma.

Earl Reed, senior superintendent in charge of operations, was president of Sun-Yount Lee Pipe Line Company.

C. B. Lester, chief engineer, who has been in charge of research and development and electronics for Sohio Pipe Line Company.

Marshall Muse, dispatcher. Muse has had 17 years' service with Sun Oil Company in various dispatching and gaging assignments. His last post was in the Seabreeze division.

John Montfort, staff assistant to President Morrill, has spent the last 2

years as an engineer with Sohio Pipe Line Company.

Don J. Ward, purchasing agent, has had 26 years' experience with Tide Water and Sohio pipe lines doing purchasing and clerical work. His last post was chief clerk of the Eastern division for Sohio.

Carl Compton, chief of communications and instruments, has been communications engineer for Sohio Pipe Line.

Members of the board of directors are:

W. C. Kinsolving, chairman; Edward F. Morrill, Charles R. Perkins, B. K. Morris, M. E. Newcommer, and J. R. Shipley.

The Mid-Valley system is divided into 3 divisions for operating and maintenance purposes. Earl Read is superintendent of Division No. 1 from Longview, Texas, to Mayersville, Mississippi. Melvin Crist is superintendent of Division No. 2, which extends from Mayersville to Denver, Tennessee. He formerly was superintendent of the New York division of the Susquehanna Pipe Line Company. William Haught is superintendent of Division No. 3, Denver to Lima, Ohio. He has been superintendent of the Eastern division of Sohio Pipe Line Company.

Mid-Valley has recently established its headquarters in the Bramlette Building, Longview, Texas.

Coating and wrapping equipment operating under difficulties in mud of Louisiana.

Contractors

A total of 16 contractors engaged in construction of the line, building of pumping stations, and installation of the communications system. For line construction these included:

Burden Construction Company—63 miles from Longview, Texas, to Dixie, Louisiana.

Latex Construction Company—41 miles from Dixie to Haynesville, Louisiana; 120 miles from Haynesville to Mayersville, Mississippi; Mississippi and Red River crossings.

Associated Pipe Line Contractors, Inc.—111 miles from Mayersville, to Holly Springs, Mississippi.

Houston Contracting Company—105 miles from Holly Springs to Hornsby, Tennessee.

Eastern Construction Company—155 miles from Hornsby to Russellville, Kentucky.

Britton Contracting Company—89 miles from Russellville to the vicinity of Fort Knox, Kentucky; and the Ohio River crossing.

Eastern Construction Company—22 miles from the vicinity of Fort Knox to Salt River.

H. L. Gentry Construction Company—90 miles from Salt River to Hebron, Kentucky.

Mahoney Contracting Company—120 miles from Hebron to Lima, Ohio.

The pump stations were contracted as follows:

Thomas Bryan and Associates—Longview, Texas.

The Dresser Engineering Company—Haynesville, Louisiana.

The Refinery Maintenance Company—Mayersville and Abbeville, Mississippi and Denver, Tennessee.

O. L. Olsen Company—Clarkson, Kentucky.

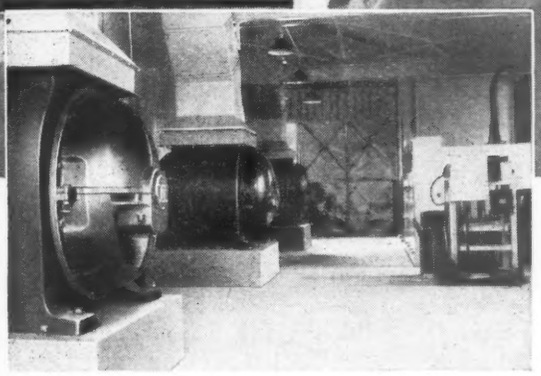
Dravo Corporation—Hebron, Kentucky.

Motorola, Inc., was awarded the contract to install microwave radio relay communications system. ★ ★ ★

Cleaning and priming on Texas-Ohio line.

MOTORS TO MATCH YOUR PIPELINE NEEDS

No firewall is needed between pumps and motors when you use G-E explosion-proof motors, as with these two 400-hp motors direct coupled to main pumps in a Pennsylvania pipeline station.



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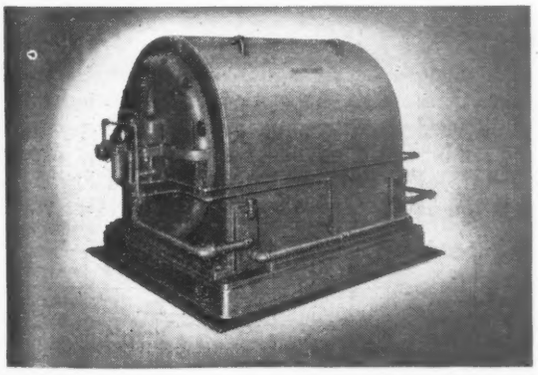

No firewall is used with this 1500 hp G-E externally forced base-ventilated motor, one of several now being installed in a large Southwestern crude line. A separate motor-driven blower purges the motor and duct system of hazardous gases. Air ducts are located below the floor level.

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New Method for Bulk Modulus Determinations*

S. LOGAN KERR[1], LEWIS H. KESSLER[2], MERRILL B. GAMET[3]

Part 2—*Conclusion*

Comparison With Water

The experimental techniques were first worked out by preliminary runs on crude oil. These tests were then made on boiled distilled water at 68 F to check the characteristics and behavior of the apparatus on a liquid for which considerable experimental results are available on compressibility at one atmosphere and at pressures above 300 psi.

Figs. 6 and 6a show the Northwestern test results as compared with data reported by 13 former experimenters. In some instances, equation 2 could be used directly and in others the bulk modulus was computed as the reciprocal of the compressibility "C", where "C" is expressed in atmospheric units, that is to say, the ratio of the decrease in volume per atmosphere of pressure to the volume of the liquid.

Tyrer[2] worked at one and two atmospheres only, Amagat,[5] and Bridgman,[5] Parsons and Cook,[5] and Jessup[8] give results at one atmosphere, in addition to higher pressures, none of which, however, were below 300 psi. All experimenters appeared to be interested primarily in the compressibility of water at high pressures. In most instances where the experimenters plot data obtained at pressures above 700 psi, they extrapolate the compressibility curve as a straight line into the low pressure range, assuming the compressibility to be independent of the change in pressure.

Parsons and Cook,[5] however, are very definite in showing that water has a bulk modulus of 200,000 psi at atmospheric pressure and 4 C and a modulus of 400,000 psi at 2000 atmospheres. Wherein this great change takes place is not shown. Northwestern tests show that the modulus is about 200,000 psi at pressures of 25 to 50 psi, which is in general agreement with the above named experimenters. Above 50 psi the modulus increases rapidly until a value of about 300,000 psi is obtained in the neighborhood of 300 psi. Fig. 6a shows an enlarged portion of the Modulus-Pressure curve in the lower pressure range.

It is concluded from a careful study of the runs on distilled water, that the accuracy of the test vessel and appurtenances and the techniques used in the Northwestern tests is comparable to that obtained with various devices or apparatus of former experimenters. This verification is important as almost all experimenters since Amagat have checked the performance of their test apparatus with distilled water as free from dissolved oxygen as is possible of attainment.

For most work on water hammer at ordinary pipe line pressures, it is evident that a modulus of 300,000 psi for water is a valid unit although some engineers use 294,000 and others 310,000 psi. If 300,000 psi is used and 30,000,000 psi as Young's modulus for steel in tension, the ratio of 1:10 in the formula for calculation of the speed of propagation of the water hammer pressure wave is within experimental error. At ordinary pipe line pressures, computations are simplified somewhat, which is probably the reason for the widely adopted value of about 300,000 psi, plus or minus 3 per cent for bulk modulus of water.

Crude Oils and Gasoline

Figs. 7a, 7b, and 7c show the plotting of test results and the curves established for the two crude oils and gasoline samples taken from the test pipe sections of the field tests utilized by the Joint Surge Conference.[13] Ten gallon samples were shipped in fluid tight metal containers to the Northwestern Technological Institute Hydraulic Laboratories for these independent bulk modulus tests. Fig. 8 shows similar test results on G.H. No. 3 crude oil shipped from the Kuwait oil fields on the Persian Gulf.

Four temperatures, 32, 60, 100, and 130 F, were maintained for each of pressure series for the three crude oils, but the 130 F temperature was not used in the gasoline tests. These temperatures cover the climatic and operating ranges usually experienced in oil pipe line work, as well as any appreciable rise in temperature caused by pipe friction. The range in pressure varied from 25 to 1500 psi, which covers the usual operating pressures of oil pipe lines.

At any given pressure, the variation of bulk modulus or compressibility with temperature is very pronounced. This has been found by all experimenters. No general conclusion can be reached as to the degree of variation

*Presented before joint Petroleum and Hydraulic Session, The American Society of Mechanical Engineers, St. Louis, Missouri, June 19-23, 1950.

[1]Consulting engineer, president, S. Logan Kerr and Company, Inc., Philadelphia, Pennsylvania.

[2]Professor, [3]associate professor, Civil Engineering Department, Northwestern Technological Institute, Evanston, Illinois.

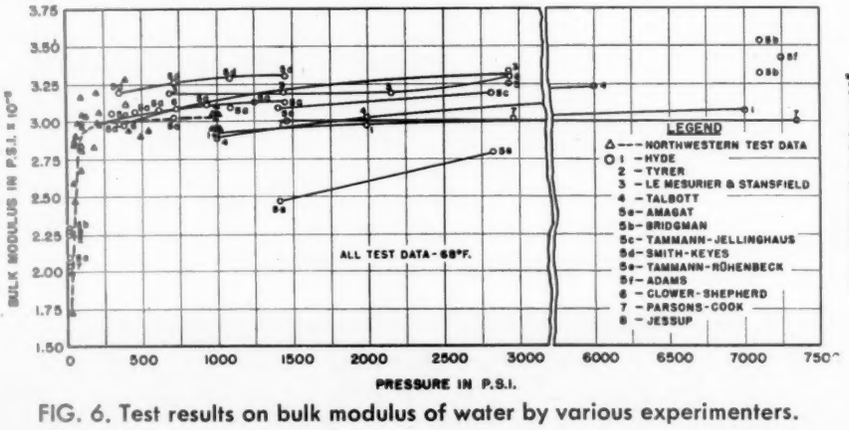

FIG. 6. Test results on bulk modulus of water by various experimenters.

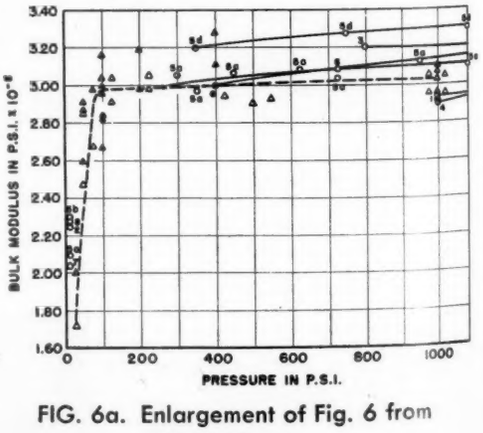

FIG. 6a. Enlargement of Fig. 6 from 0-1100 psi.

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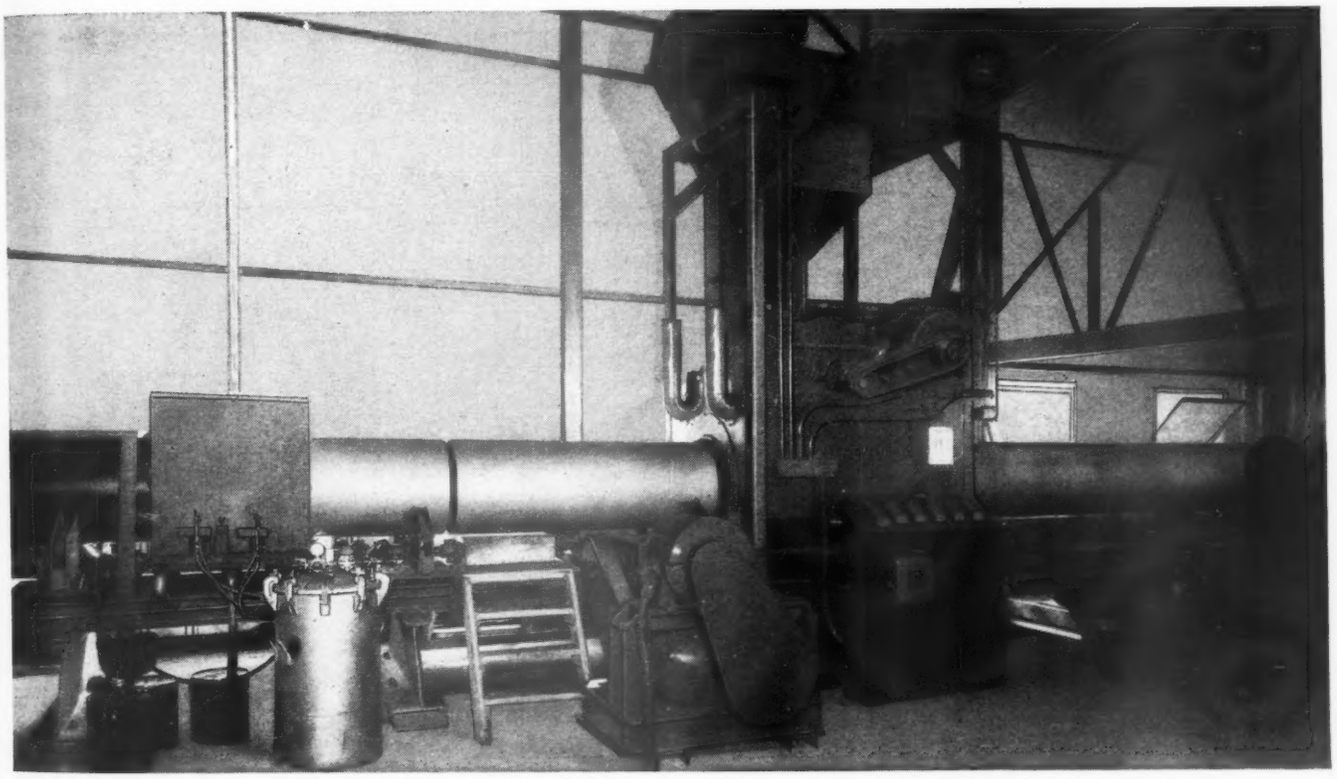

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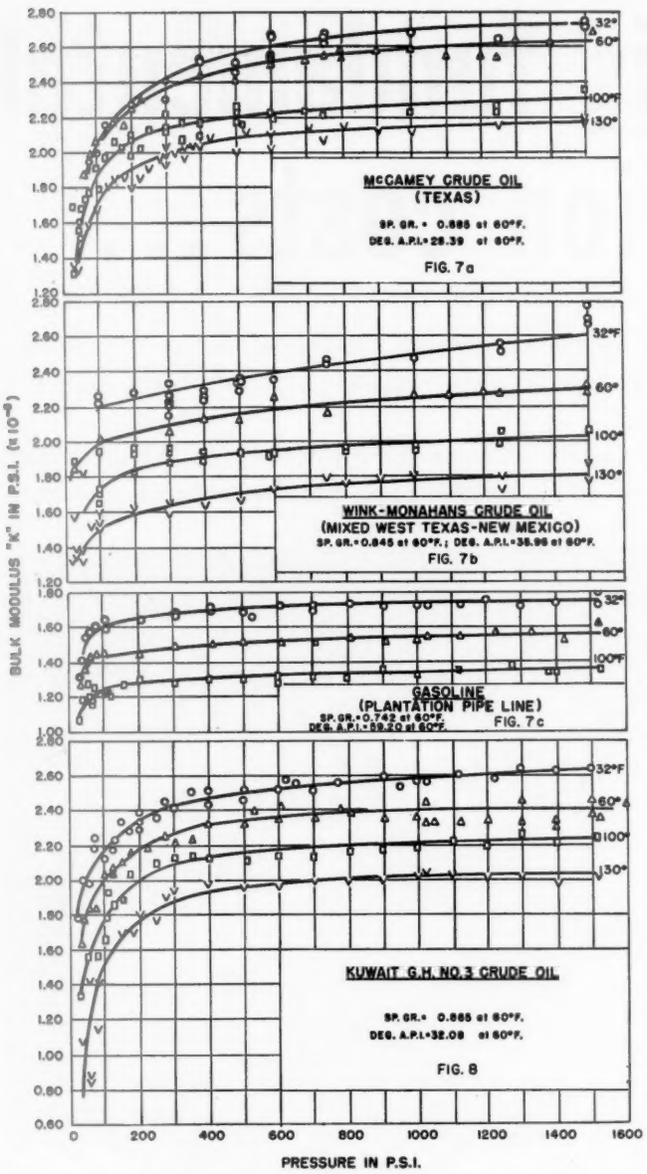

FIG. 7a, b, c and 8. Northwestern University test results on crude oils and gasoline.

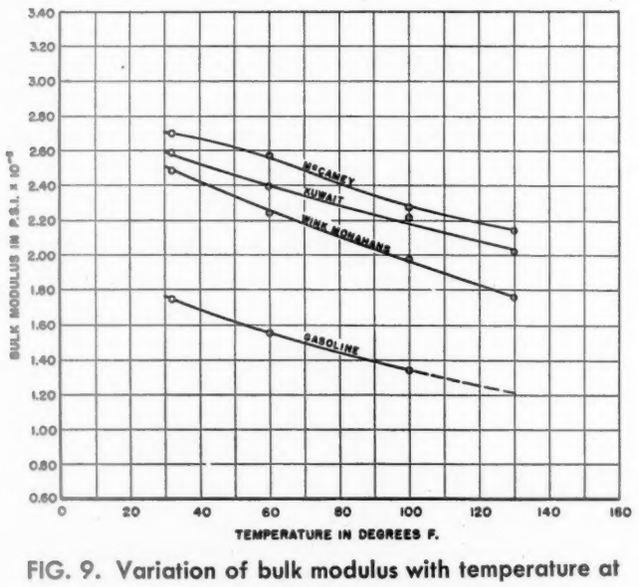

FIG. 9. Variation of bulk modulus with temperature at 1000 psi.

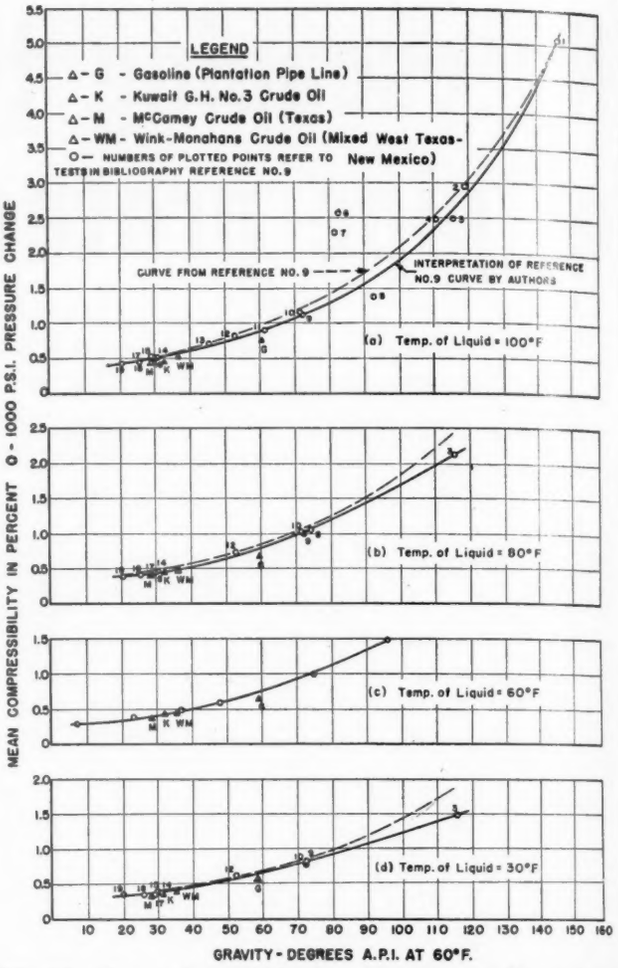
LEGEND
Δ – G – Gasoline (Plantation Pipe Line)
Δ – K – Kuwait G.H. No. 3 Crude Oil
Δ – M – McCamey Crude Oil (Texas)
Δ – WM – Wink-Monahans Crude Oil (Mixed West Texas-New Mexico)
O – NUMBERS OF PLOTTED POINTS REFER TO TESTS IN BIBLIOGRAPHY REFERENCE NO. 9
CURVE FROM REFERENCE NO. 9
INTERPRETATION OF REFERENCE NO. 9 CURVE BY AUTHORS
(a) Temp. of Liquid = 100°F
(b) Temp. of Liquid = 80°F
(c) Temp. of Liquid = 60°F
(d) Temp. of Liquid = 30°F
MEAN COMPRESSIBILITY IN PERCENT 0 - 1000 P.S.I. PRESSURE CHANGE
GRAVITY - DEGREES A.P.I. AT 60°F.

FIG. 10. Comparison of Northwestern test results on compressibility of petroleum products with results shown by Jacobson ,et al.

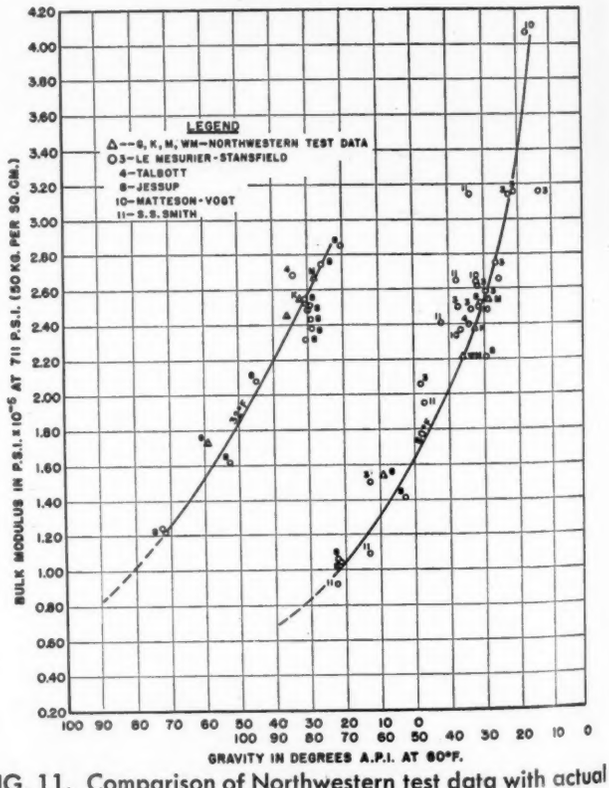
LEGEND
Δ – G, K, M, WM – NORTHWESTERN TEST DATA
3 – LE MESURIER - STANSFIELD
4 – TALBOTT
8 – JESSUP
10 – MATTESON - VOGT
11 – S.S. SMITH
32°F
60°F
BULK MODULUS IN P.S.I. x 10⁻⁵ AT 711 P.S.I. (50 KG. PER SQ. CM.)
GRAVITY IN DEGREES A.P.I. AT 60°F.

FIG. 11. Comparison of Northwestern test data with actual test data of other experimenters at 711 psi and at 32 F and 60 F.

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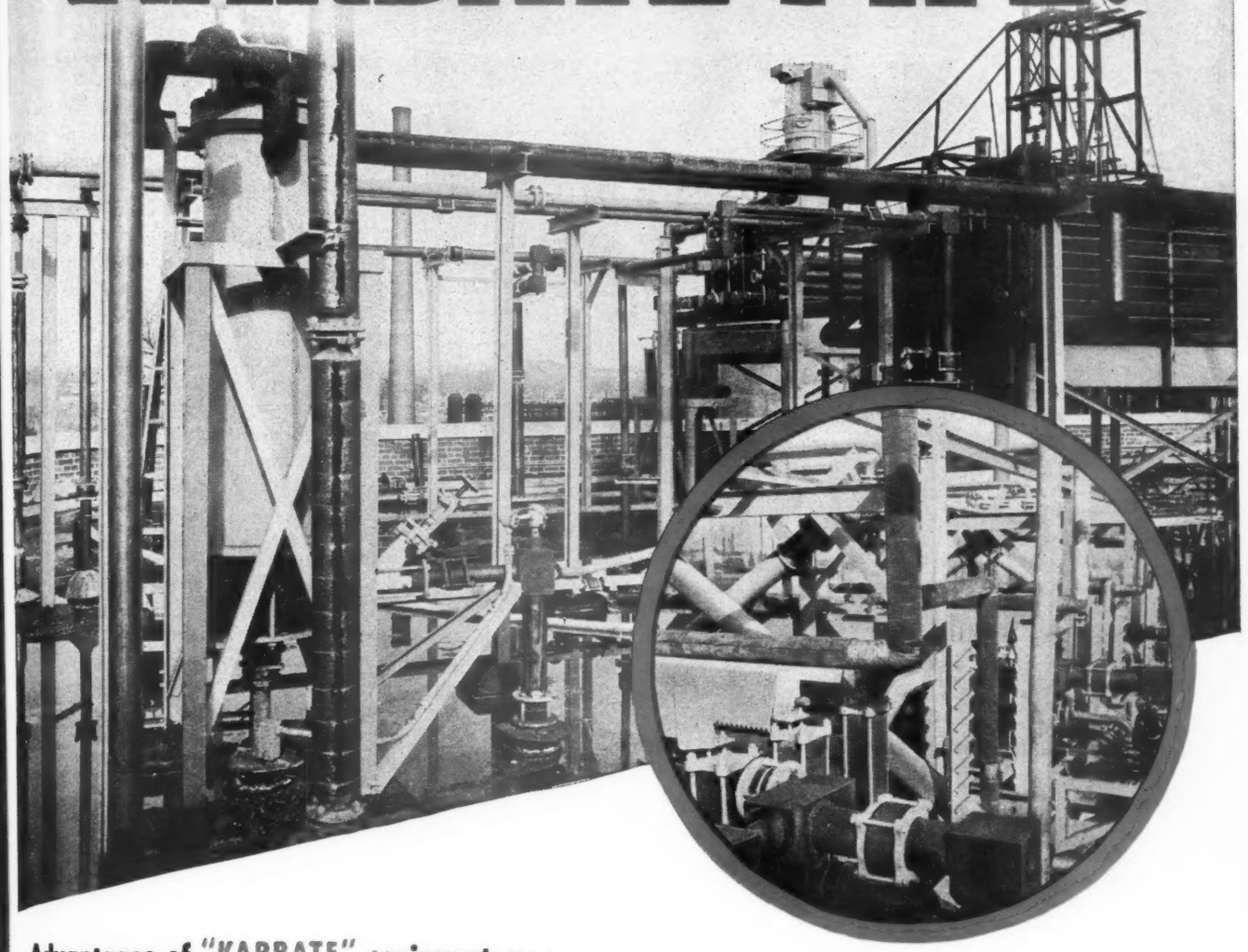

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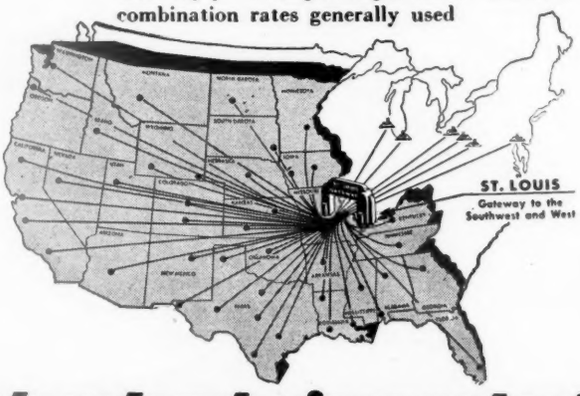

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with temperature, but in general the three crude oils and the tested gasoline seem to decrease roughly about 700 psi in bulk modulus for each degree Fahrenheit increase in temperature.

Gasoline, Fig. 7c, at pressures above 200 psi and up to 1500 psi had a relatively insignificant change in modulus with increase in pressure. Below 200 psi, the change in modulus is more pronounced.

The crudes, Figs. 7a and 7b, show that above 1000 psi the modulus remains about constant in value for any given temperature. Below 1000 psi, the modulus decreases in some degree as the pressure decreases, and below 400 psi the modulus decreases quite rapidly in some cases. Between 400 and 50 psi at 60 F the McCamey crude shows a drop of 62,000 psi or 25 per cent; Wink-Monahans crude shows a decrease of 25,000 psi or 12 per cent; the Kuwait crude, Fig. 8, shows a decrease of 53,000 or 23 per cent.

Fig. 9 shows a plotting of variation of bulk modulus with temperature at a pressure of 1000 psi for the four samples tested. Until considerable additional information is available, it appears evident that petroleum products cannot be tested at just one temperature and a satisfactory conclusion arrived at for the bulk modulus at any other temperatures. In studying the test data of other experimenters it was impossible, in most instances, to determine the compressibility or bulk modulus at temperatures other than within the range of the test. Water at one atmosphere of pressure when tested by four experimenters shows that variation with temperature follows no well defined law.

Mean Compressibilities

The test values of bulk modulus in the Northwestern tests were computed also in terms of mean compressibility in per cent from zero to 1000 psi in order to compare results with the study in the American Petroleum Institute progress report made by Jacobson.[9] Values are plotted relative to API gravity at 60 F in all cases, Fig. 10. Undoubtedly other factors than specific gravity modify this simple relationship. Viscosity is one factor as is shown by Matteson[14] where he uses the Cragoe modulus to extrapolate test data on compressibility of oils at 711 psi to values at higher pressures. The authors interpreted the data by Jacobson, et al[9], somewhat differently and the solid line curves show their estimate of the reported test values. An assumed curve has been drawn for 60 F as no data existed for this temperature.

The graphical studies, Fig. 10, show close agreement between the test data

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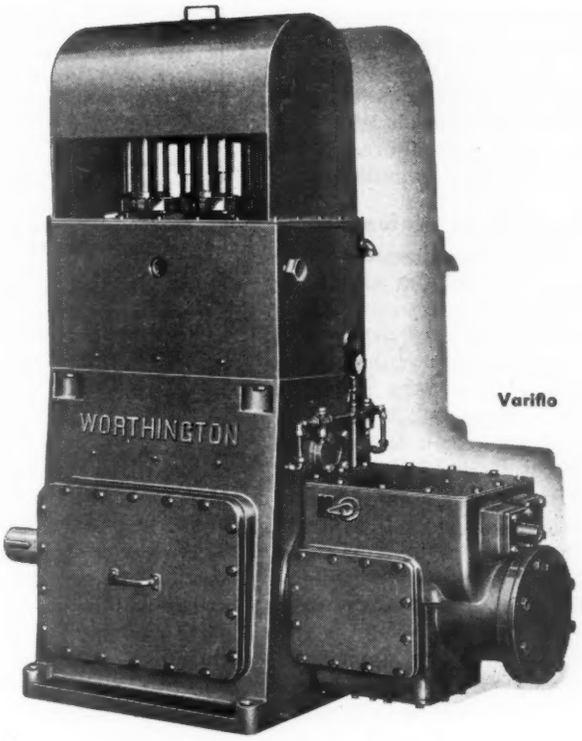

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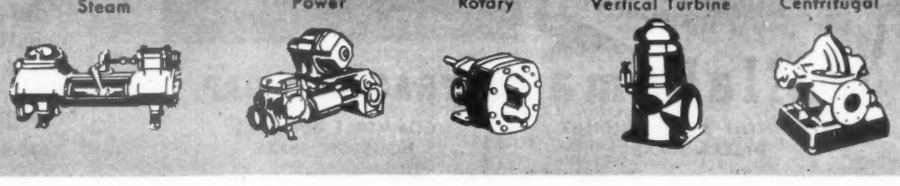

used by Jacobson and the Northwestern test data at the higher pressure. A possible hazard exists in using data plotted in this way, because a small change in per cent compressibility means a much more significant change in the numerical value of the bulk modulus and a consequent error in the surge wave velocity computation.

Bulk Modulus Values

Fig. 11 shows a comparison of the Northwestern test data at about the median of test pressure with actual test data at 32 F and 60 F determined by other investigators. Library research disclosed that very few tests exist at lower pressures. A few tests have been found with a temperature gap as large as from 32 F to 167 F. Gravity in degrees API at 60 F is used as abscissae, as in Fig. 10, but the ordinate is the bulk modulus instead of per cent compressibility. Several experimenters used 50 kg per square centimeter or 711 psi, which is the reason for selecting this apparently odd pressure value. Only the temperatures shown could be used, as these were the reported results and no interpolation or extrapolation of test data is resorted to in the figure.

Fig. 11 shows the apparent variation in bulk modulus with API gravity in a more useful light for liquid hammer purposes than if per cent compressibility is used. It also gives an opportunity to include a few more test data points than are shown by Jacobson[9]. Curves drawn by the authors indicate that the Northwestern tests are in general agreement with the results by others, but a considerable variation in bulk modulus for a given API gravity is manifest. The graphs

QUOTES

One of the most useful tricks of the trade of the research worker is to use failures as stepping stones to success. The engineering research man also must watch developments and events beyond range of the research goal he is aiming toward. Because nature sometimes proffers gifts with her left hand as well as her right, it's a good idea to keep your eye on her left hand, too. That was how Roentgen discovered X-rays by noticing that a photographic plate wrapped in black paper and lying on the table had become fogged. At the time, Roentgen was merely trying to photograph the well-known electric discharges in a vacuum tube.

T. A. Boyd
Research Consultant

indicated to the authors that further investigations are needed in order to arrive at more definite conclusions as to the variation of bulk modulus with specific gravity. By interpolation and extrapolation of existing data with some risk as to accuracy of the conclusions, it is possible to show a relationship between values of bulk modulus of petroleum products and API gravity. Unfortunately, in order to do this, data must be used at pressures substantially above usual pipe line pressures.

Fig. 12 is similar in scope to Fig. 11, but shows the Northwestern test results at a pressure of 1000 psi for 80 F and at 100 F compared with the results by others. The points shown are in some cases actual test data points, but in other cases they are points obtained by either interpolation or extrapolation of actual test data.

The solid line curves of Fig. 12 are obtained from Jacobson[9] who used data by Jessup,[8] Sage and Lacey et al,[12] to determine first the shape of the curve at 1000 psi and 100 F. This made it possible to determine the trend of the curves shown in Fig. 10, 11, and 12 at temperatures where only meager data is available. It appears from these comparisons that Jacobson's curves represent the *minimum* bulk modulus values for API gravities at 60 F. The dashed line curves drawn by the authors represent their estimate of an *average* determination of the relation of modulus to API gravity. The dot and dash curves show the *maximum* envelope of existing data.

Discussion of Curves

Fig. 12 indicates that for petroleum products under a pressure of 1000 psi and with gravity above 90-deg API the bulk modulus is a fairly well defined value.

As the API gravity decreases below that of gasoline at about 60, variation in bulk modulus from the Jacobson curve is more pronounced. When the lower range in gravity is reached, in the neighborhood of the crude oils at API gravity of about 35, the variation is more significant. Fig. 11 shows that the above statements are probably correct for pressures as low as 700 psi, although at that pressure no test data could be found by the authors on products having a gravity greater than 75-deg API. At the lower pressures the variation in bulk modulus with pressure is even more significant, as shown in Figs. 7 and 8.

Comparison With Field Results

In the field test program carried out by the Joint Surge Conference, the actual velocity of the pressure wave could be determined, based on the synchronized pressure time recordings at various points along the test sections. The accuracy of this measurement was probably on the order of 1 per cent to 2 per cent, depending on the particular location involved.

By taking the data on the McCamey crude plotted in Fig. 7a and interpolating between the 32 and 60 F curves, a 45 F curve can be obtained fairly accurately. This was the temperature existing during the field tests and the bulk modulus vs. pressure is shown as the solid line in Fig. 13a. If the assumption is made that the compressibility is uniform from zero to 1000 psi or higher, then a line tangent to the curve between approximately 800 psi and 1500 psi can be extrapolated back to zero. This is shown as the broken line on Fig. 13a. It is believed that this particular procedure has been used in many instances to obtain the bulk modulus in the lower pressure ranges.

Table 1 shows the theoretical value of the velocity of the pressure wave,

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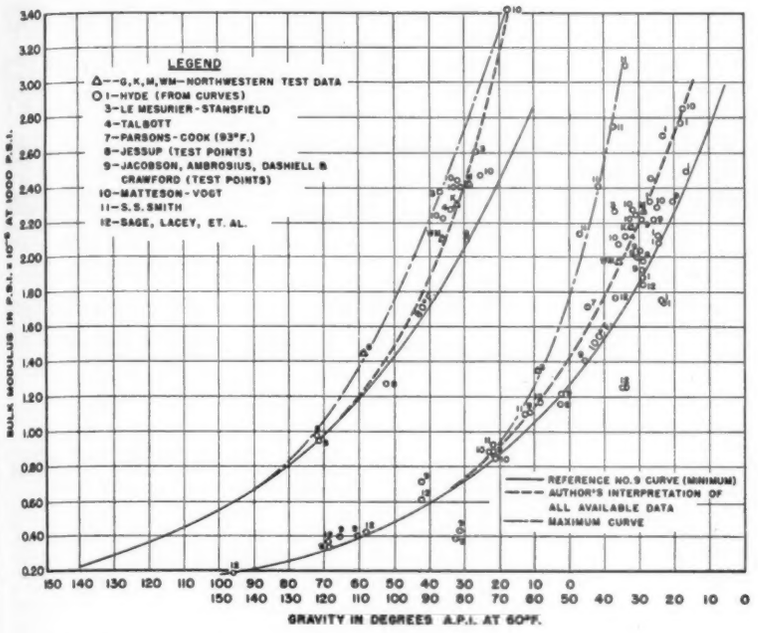

FIG. 12. Comparison of Northwestern test data with data of other experimenters at 1000 psi and at 80 F and 100 F.

based on the 45 F Northwestern curve and that obtained from the extrapolated line. The measured values from the field tests are given for comparison.

TABLE 1. Comparison with field tests.

Line pressure, psi	McCamey crude at 45 F Bulk modulus, Northwestern tests	Extrapolated line
125	212,000	256,000
150	218,000	256,500
175	223,000	257,000
Mean value "K"	218,000	256,500
Velocity of pressure wave "a" Calculated	3980ft/sec	4296ft/sec
Test (Av. of 10)	3998ft/sec	

It will be seen that the calculated value on this basis, using the 45 F Northwestern curve, is 3980 ft per second, based on a mean value of "K" equal to 218,000 psi. Ten of the field tests were examined and the average velocity of the pressure wave was found to be 3998 ft per second. The maximum value was 4090 ft per second and the minimum 3880 ft per second.

Applying this same procedure to the extrapolated curve, a mean value of 256,500 psi is obtained, or about 17.5 per cent higher than the Northwestern value. When this is used in the theoretical formula for the velocity of the pressure wave, a value of 4296 ft per second is obtained and is nearly 8 per cent higher than the average of the field tests.

Similar comparisons were made with the tests on the Wink-Monahans crude, shown in Fig. 13b, and the extrapolated curve, covering pumping tests, give a value about 2 to 3 per cent higher than would the Northwestern tests.

In the Plantation series, the curves shown in Fig. 13c were obtained on gasoline at 72 F. In this case, the tests in the field indicated a velocity of 3620 ft per second, with a calculated value from the Northwestern tests of 3590 ft per second, as compared with 3640 ft per second using the extrapolated curve.

It is evident that there is considerable variation from crude to crude and between crudes and refined products in the relationship between bulk modulus and pressure at a constant temperature. Where these curves do not depart by more than 5 per cent at the low pressures, an error in the velocity of the pressure wave can be quite small, probably on the order of 2 to 3 per cent.

In the case of the McCamey crude, however, the difference in the weighted mean of the bulk modulus value was more than 17 per cent and the calculated value, using this figure, 7 to 8 per cent higher than that measured in the field.

Fig. 8 shows the results of the tests on a crude from the Middle East and it will be noted that this material behaves more nearly like the McCamey crude and thus the possible error in determining the velocity of the pressure wave and the magnitude of surges, as well as the damping of surges, would be appreciable.

Conclusions

In any surge investigation where an accuracy closer than 5 per cent is desired in the determination of maximum surge pressures and the degree of damping of waves, it would be

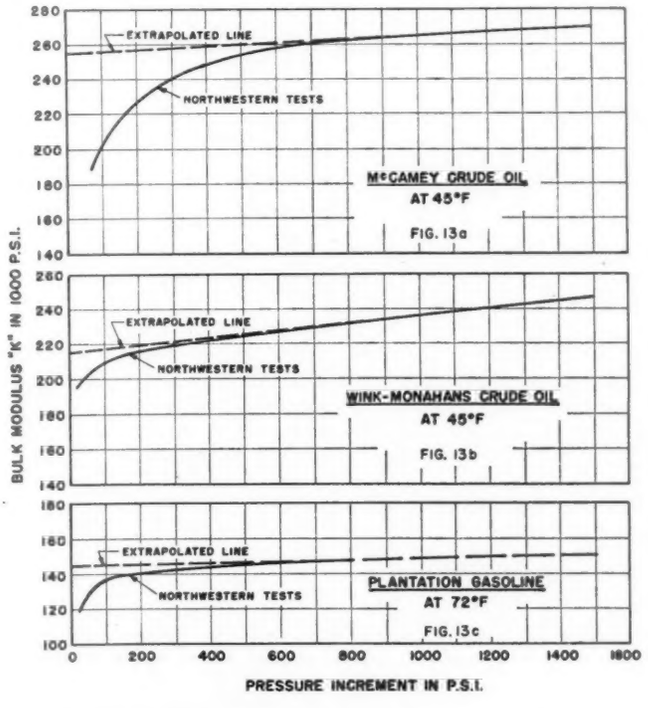

FIG. 13. Comparison of bulk modulus test values at low pressures with values extrapolated from high pressure range.

highly desirable to determine experimentally the bulk modulus of the material or materials to be transported in the line.

This is particularly desirable when there is a substantial variation in temperature, as well as variations in pressure in the system, so that such effects can be taken into account in any investigation.

The means of obtaining bulk modulus data has been greatly simplified through the use of the apparatus described in this paper and results can be made available in a matter of a few days after a sample has been received at the laboratory.

Where there are large investments in pipe lines and particularly when low factors of safety are used in the design, it would seem highly desirable to know the bulk modulus data in addition to the usual information concerning specific gravity, and viscosity variations with temperature, and thus provide more accurate basis of design than if pure assumptions from meager data are relied upon.

Bibliography

1. "On the Viscosities and Compressibilities of Liquids at High Pressures", J. H. Hyde, *Proceedings Royal Society*, London, A97, 1920, 240-249.
2. "Adiabatic and Isothermal Compressibilities of Some Liquids Between One and Two Atmospheres", D. Tyrer, *Journal Chemical Society of London, Transactions CIII*, Part II, 1913, 1675-1688.
3. "Fuel Characteristics in Relation to Pump and Sprayer Action", L. J. LeMesurier and R. Standfield, Diesel Engine Users Association, 307 Abbey House Westminster, S.W. 1, London, March 30, 1933, 1-33.
4. "Velocity of Pressure Waves in Oil Under Pressure", A. C. Talbott, *Philosophical Magazine*, Vol. 19, 1935, 1126-1141.
5. "Properties of Ordinary Water-Substance", N. E. Dorsey, *American Chemical Society Monograph Series No. 81*, Reinhold Publishing Corporation, New York, 1940, p. 207-224.
   (a) E. H. Amagat, Sections I and II, p. 207.
   (b) P. W. Bridgman, Sections III and IV, p. 214.
   (c) G. Tammann and W. Jellinghaus, Section V, p. 216.
   (d) L. B. Smith and F. G. Keyes, Section VI, p. 219.
   (e) G. Tammann and A. Ruhenbeck, Section VII, p. 222.
   (f) L. H. Adams, Section VIII, p. 224.
6. "Correcting for Fluid in Hydraulics", J. I. Clower and H. F. Shepherd, *Machine Design*, November, 1932, p. 24-27.
7. "On the Compression of Liquids at High Pressures", C. A. Parsons and S. S. Cook, *Proceedings Royal Society of London*, Series A, Vol. 85, No. A 579, July 5, 1911, p. 332.
8. "Compressibility and Thermal Expansion of Petroleum Oils in the Range 0° to 300° C", R. S. Jessup, *Bureau of Standards Journal of Research*, Vol. 5, No. 5, November, 1930, pp. 985-1039.
9. "Compressibility of Liquid Hydrocarbons", Second progress report on study of existing data, E. W. Jacobson, E. E. Ambrosius, J. W. Dashiell, C. L. Crawford, *Proceedings American Petroleum Institute*, Vol. 25 (IV) 1945, pp. 39-41.
10. "Velocity of Compressional Waves in Petroleum Fractions at Atmospheric and Elevated Pressures", R. Matteson and C. J. Vogt, *Journal of Applied Physics*, Vol. 11, October, 1940, pp. 658-665.
11. "Product Pipe Line Developments", S. S. Smith, *Proceedings American Petroleum Institute*, Vol. 23 (IV), 1942, p. 58.
12. *Industrial and Engineering Chemistry*
    (a) "Pressure, Volume and Temperature Relations, and Thermal Properties of Pentane", B. H. Sage, J. G. Schaafsma, and W. N. Lacey, Vol. 26, September, 1934, p. 1218.
    (b) "Thermo Properties of Normal Pentane", B. H. Sage, W. H. Lacey, and J. G. Schaafsma, Vol. 27, January, 1935, p. 48.
    (c) "Physical and Thermal Properties of Crude Oil", B. H. Sage, W. N. Lacey, and J. G. Schaafsma, Vol. 27, February, 1935, p. 162.
    (d) "Methane-Crystal Oil System", B. H. Sage, H. S. Backus and W. N. Lacey, Vol. 27, June, 1935, p. 686.
    (e) "Thermo Behavior of Liquid Mixtures of N-Butane and Crystal Oil", B. H. Sage and W. N. Lacey, Vol. 28, January, 1936, p. 106.
    (f) "Thermo Properties of Mixtures of a Crude Oil and Natural Gas", B. H. Sage, and W. N. Lacey, Vol. 28, February, 1936, p. 249.
    (g) "Mixtures of Methane and a Crude Oil", B. H. Sage. D. C. Webster, and W. N. Lacey, Vol. 28, August, 1936, p. 984.
    (h) "Thermo Properties of Ethane", B. H. Sage, D. C. Webster, and W. N. Lacey, Vol. 29, June, 1937, p. 658.
    B. H. Sage, D. C. Webster and W. N. Lacey, Vol. 29, October, 1937, p. 1188.
    (i) "Thermo Properties of N-Butane," B. H. Sage, D. C. Webster and W. N. Lacey, Vol. 29, Oct. 1937, p. 1188.
    (j) "Thermo Properties of Iso-butane", B. H. Sage and W. N. Lacey, Vol. 30, June, 1938, p. 673.
    (k) "Methane-Decane System", B. H. Sage, H. M. Lavender and W. N. Lacey, Vol. 32, May, 1940, p. 743.
    (l) "Methane and N-Butane in the Gaseous and Liquid Regions", B. H. Sage, R. A. Budenholzer and W. N. Lacey, Vol. 32, September, 1940, p. 1262.
13. "Final Report of Joint Surge Conference covering Field Investigations on Oil Pipe Lines Conducted During 1949", sponsored by Middle East Pipelines Limited, Trans-Arabian Pipe Line Company, and Gulf-Shell Pipe Line. Available on loan from Libraries of ASCE, ASME, AWWA, API, Eng. Inst. of Canada, Institution of Mechanical Engineers, and Institution of Civil Engineers, London, England.
14. "Compressibility and Velocity of Pressure Waves in Petroleum Oils", R. Matteson, *Journal of Applied Physics*, Vol. 9, January, 1938, p. 44.

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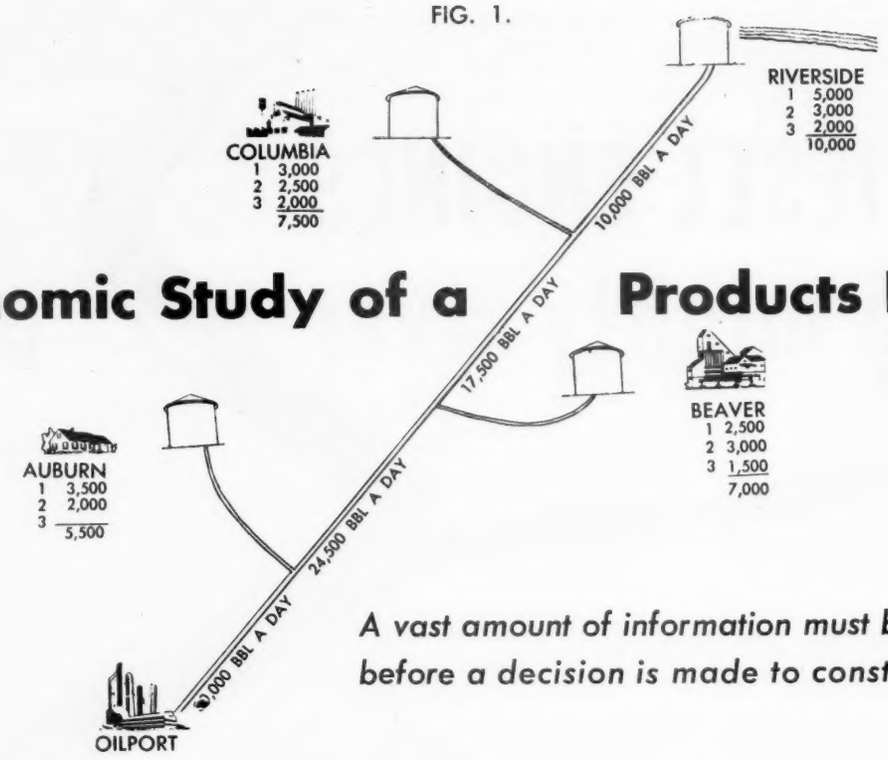
FIG. 1.



An Economic Study of a Products Pipe Line

A vast amount of information must be collected before a decision is made to construct a line.

R. H. LYNCH[1]

WHEN your committee began to assemble a program for this meeting we entertained a suggestion to present to you a brief summary of the information that is gathered together before a decision is made to build a products pipe line. There are many ways to present these data. This discussion deals with one of the methods of presentation. What we have here, in essence, are some figures relating to the very early planning of a products pipe line system.

In developing this, however, we do not intend this presentation to be too technical, nor to represent our figures as being handbook data for construction and operations costs. We intend, rather, to simply present some comparisons to point out to you the factors that effect the economics of any proposed venture, and must therefore be considered before proceeding with the project.

Now, having protected ourselves with this equivocal beginning, let's proceed to the examination of our proposed pipe line.

First of all, it is assumed that a need for a pipe line exists and that figures have been obtained from prospective shippers so that the petroleum product requirements of the contiguous trade areas are known. A hypothetical pipe line is shown as Fig. 1. This map

FIG. 2. Proposed route on U. S. geological survey map.

*Presented before American Petroleum Institute Products Pipe Line Technology Conference, St. Louis, Missouri, September 11-13, 1950.

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indicates a 400 mile long system serving three shippers. The shippers' products are to be moved from a tidewater source across a sales area to an inland water terminal with terminals at mythical towns. The first terminal is at Auburn, a residential community. Another terminal is shown located at a mining center, which we have named Beaver. This town is assumed to be in a mountainous area as will be shown later. The next terminal is supposed to serve a manufacturing center at a town we have called Columbia. The terminus of the line is at a terminal or terminals situated on an inland waterway and has been named Riverside. All the terminals have been arbitrarily shown to be 100 miles apart to avoid complication in the presentation. The source of supply for the trade area has been called Oilport and could be a series of deep water terminals or a refining center.

The shippers proposing to use the line are simply named 1, 2, and 3 and Fig. 1 shows the volume in barrels per day required by each shipper at the terminal points. From these figures, by addition, the total demand for each terminal is obtained. In the same manner the total volume in barrels per day for each section of the line can be determined. This also appears in Fig. 1.

Having this information, we then proceed to lay out the pipe line on U. S. Geological Survey sheets. Having mapped the proposed route, a profile can be prepared by reading the contour lines from the U. S. Geological Survey maps and plotting the elevations. How this is done is shown in Fig. 2. The proposed route of the pipe line is laid out on the maps so as to have the terminal locations in a satisfactory position for truck or rail distribution from these points. If existing terminal sites are to be connected, the line must obviously connect to these locations. If new terminals are to be built, then the desire of the shippers in this respect must be ascertained and either satisfied or acceptable compromises obtained. Fig. 3 shows the profile obtained by plotting the elevations taken from the U. S. Geological Survey maps.

With the use of graphs the hydraulic data can be shown on the profile and thus we can determine the number of pump stations required for a given rate of flow. (See Fig. 4.) The hydraulic gradient, that is, the slope of the graph from pump station to pump station, is determined for the size of pipe, the liquid flowing and the rate of flow and is readily obtainable in almost any textbook on the subject. All accepted methods are simply a

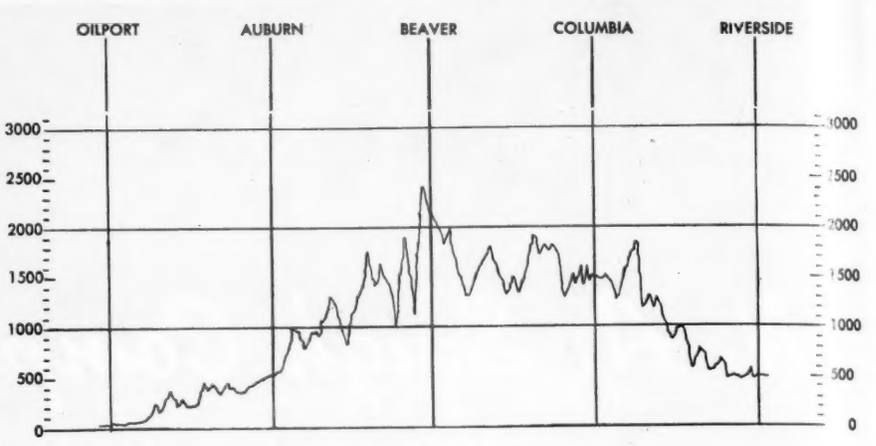

FIG. 3.

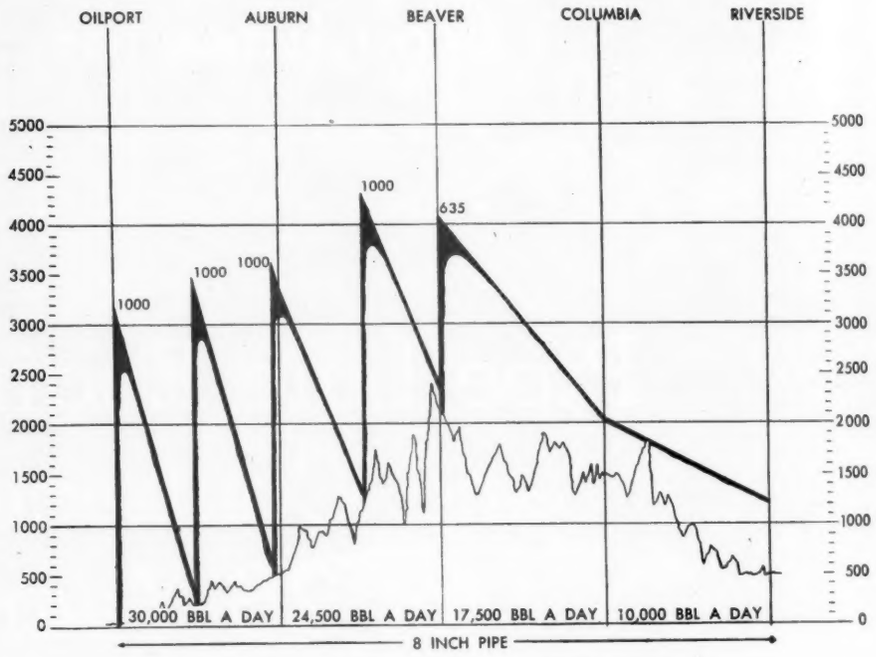

FIG. 4. Plan A—8-in. all the way—30,000 bbl a day.

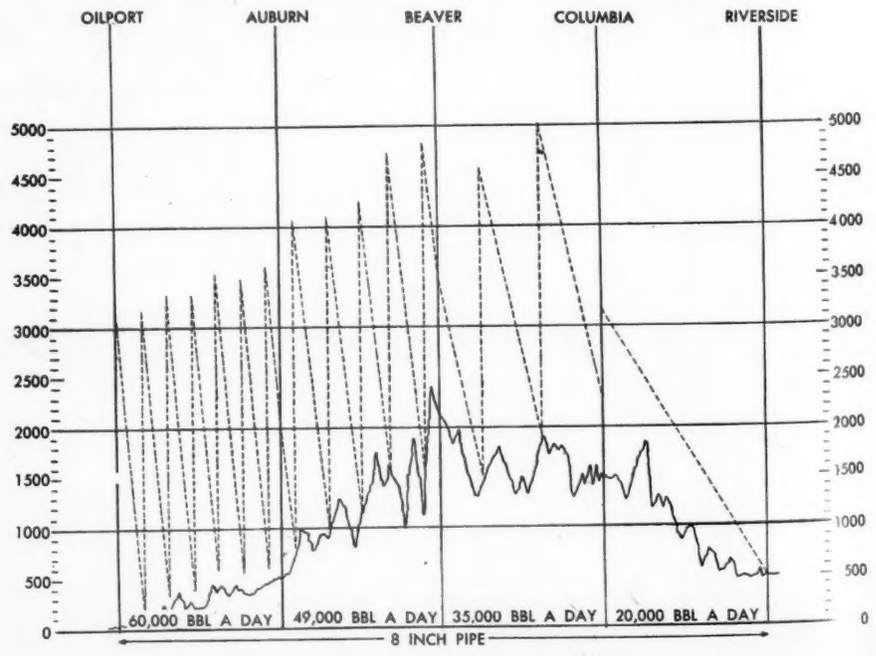

FIG. 5. Plan A—8-in. all the way—60,000 bbl a day.

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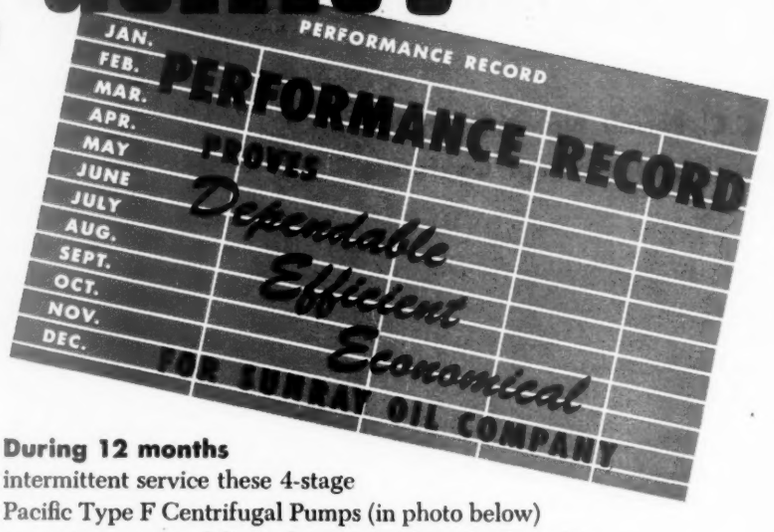

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variation of the original D'Arcy formula. The data presented here have been obtained with a Hazen and Williams slide rule, using a C factor of 150. These figures are simply the friction loss that occurs in a smooth pipe because the liquid is flowing through the pipe. The C factor is a value that reflects the relative smoothness of the interior of the pipe. You can see that it is also possible to obtain the pressure of the flowing liquid at any point on the pipe line by measuring the distance from the profile to the gradient.

Plan A. The hydraulic data for an 8-in. pipe line at 30,000 bbl per day is shown on Fig. 4. The upright shaded lines represent the location of pumping stations operating at 1000 psi pressure and 30,000 bbl per day throughput in the initial section, 24,500 bbl per day through the second section, 17,500 bbl per day through the third section and finally, 10,000 bbl per day through the last section.

This volume, which represents the shippers' requirements at the time the line is first put in operation, would be a relatively easy job for an 8-in. line, requiring five pump stations to move the required volumes, and this probably would be a financially satisfactory design. But experience has shown that most products lines can look for a 100 per cent increase in business in 8 to 10 years. Now, if we project this increase in sales of product 10 years ahead, then the hydraulic requirements of an 8-in. line at 60,000 bbl per day produce the formidable picture shown on Fig. 5. You will notice that quite a few pumping stations are required.

Plan B. This immediately suggests larger diameter pipe, at least part way, so we increase the first two sections, that is to say, the first 200 miles of the line, to 10-in., the balance remaining 8-in.

As you can see from Fig. 6, at 30,000 bbl per day this plan would require only 3 pump stations, but at 60,000 bbl per day, we would still need 8 pump stations to handle the average volumes.

Plan C. Continuing the 10-in. pipe to the third terminal, that is, 300 miles of 10-in. and the last remaining 100 miles at 8-in. pipe size, produces a system that reduces the pump stations required initially to two. At 60,000 bbl per day there would have to be 6 pumping stations. (See Fig. 7.)

Plan D. As a final step in this hydraulic study, let's take a look at 12-in. pipe for the first two sections, that is, 200 miles, and 10-in. pipe for the other 200 miles. This would require only two pump stations for the initial volume, and three pumping stations

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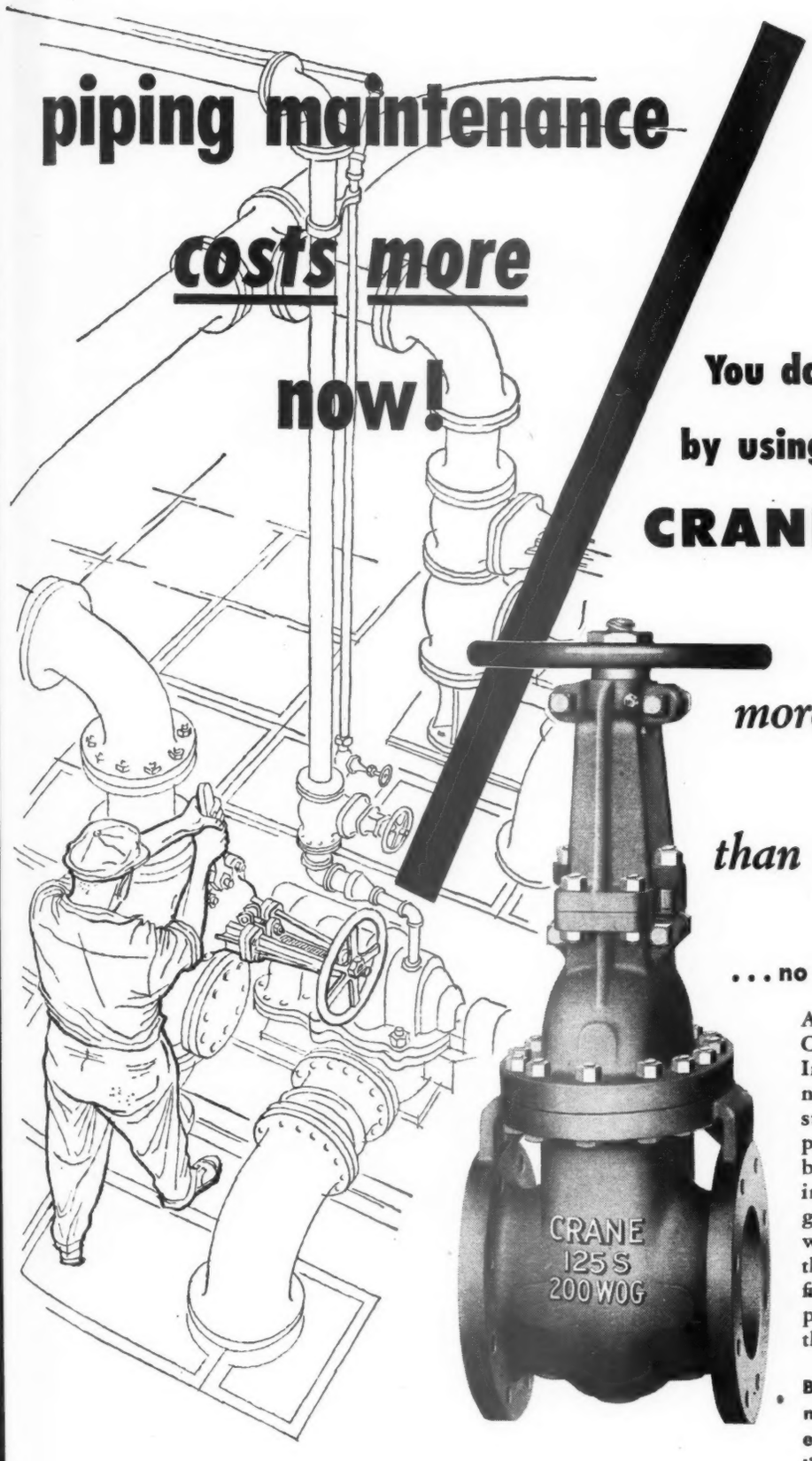

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for the 60,000 bbl per day business. (See Fig. 8.)

This decrease in stations is all very well, but the larger diameter pipe and its construction cost more money, too, and there must be a proper balance between the two.

Costs and Return

So, let's take a look at the financial picture of these various schemes. For the 8-in. system we have estimated amounts of money shown on the chart for various barrels per day of throughput. The figures on the abscissa are expressed in barrels per day of throughput. The ordinates are in dollars per year. (Fig. 9.)

The depreciation charges are an almost fixed amount of money, but, if you will look closely, you will see that it increases somewhat as the throughput goes up. This is due entirely to the increase in investment because of the increased number of pumping stations. Depreciation has been figured

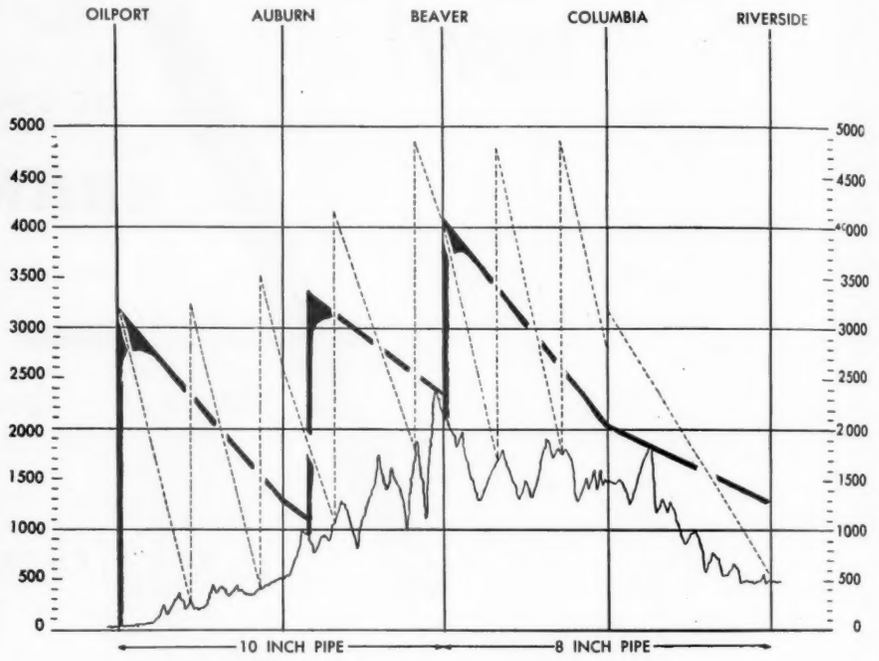

FIG. 6. Plan B—10-in. to Beaver—8-in. to Riverside. Heavy line, 30,000 bbl a day—dotted line, 60,000 bbl a day.

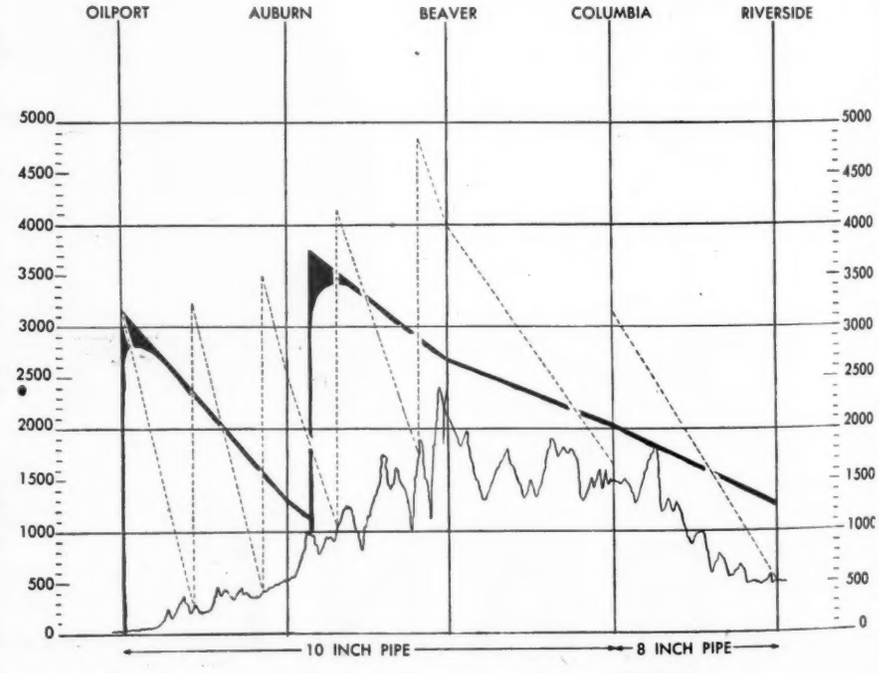

FIG. 7. Plan C—10-in. to Columbia—8-in. to Riverside. Heavy line, 30,000 bbl a day—dotted line, 60,000 bbl a day.

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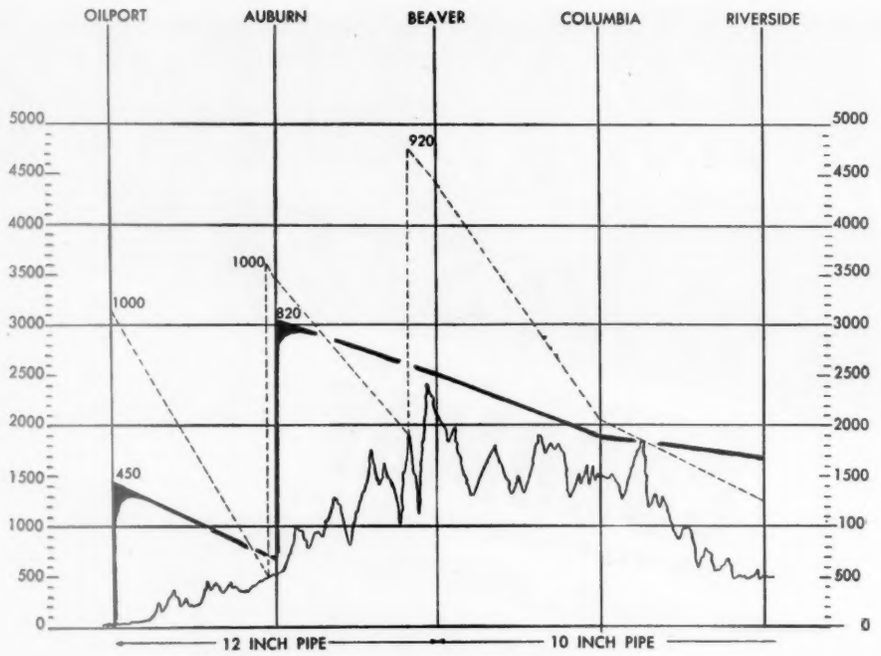


FIG. 8. Plan D—12-in. to Beaver—10-in. to Riverside. Heavy line, 30,000 bbl a day—Dotted line, 60,000 bbl a day.

at 5 per cent and the numbers used are those for the depreciation in the first year of useful life.

Pipe line maintenance costs are plotted at a fixed rate on the assumption that maintenance of the pipe line itself (exclusive of pump station and similar equipment) costs the same at 10,000 bbl per day as at 60,000 bbl.

Operation costs as plotted reflect the increase in power costs for the higher volumes, increase in personnel required to operate the additional pumping stations, and increased mechanical maintenance costs for the additional pump station and delivery facilities.

Administration costs have been figured on a flat percentage of operation and maintenance costs combined.

Transportation taxes (a federal impost) have been calculated at 4½ per cent and vary directly with the volume pumped.

All other taxes have been lumped together and include real estate, local state, and federal taxes, which are of non-variable (that is, fixed) type.

Federal income taxes have been figured from the point at which the project begins to earn net income and assumes enormous proportions as the income increases.

You will notice that this chart shows the pipe line must move about 12,000 bbl per day to pay its operating charges. This point is sometimes referred to as the "break-even" point. At 30,000 bbl per day there would be $630,000 earnings at the end of the year for use as dividends or interest on the investment, depending on the method of financing the venture; and at 60,000 bbl per day there would be $1,077,000 left for these purposes.

In order to draw even this preliminary chart considerable thought must be given to the line representing "Revenue." This *could* be considered as the end result of the study—that is, how much must we charge in our tariff to earn a fair return on the investment. On the other hand, the tariff rate may be set by other circumstances, mainly competition from other lines, or waterways. We have used a figure of 8 cents per 100 bbl-mile for calculating the revenue of our theoretical line. This seems reasonable to meet competition and realize a fair return.

Following a similar approach, we

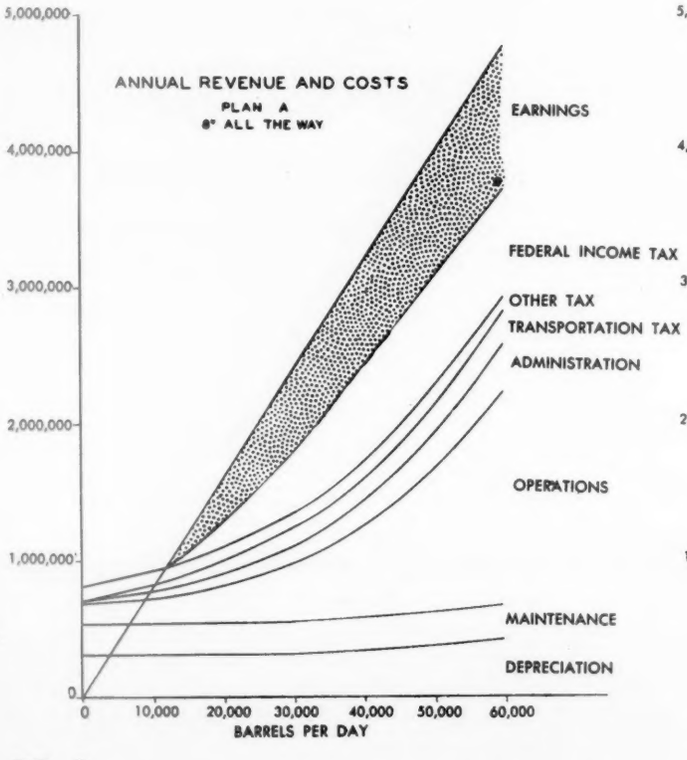


FIG. 9.

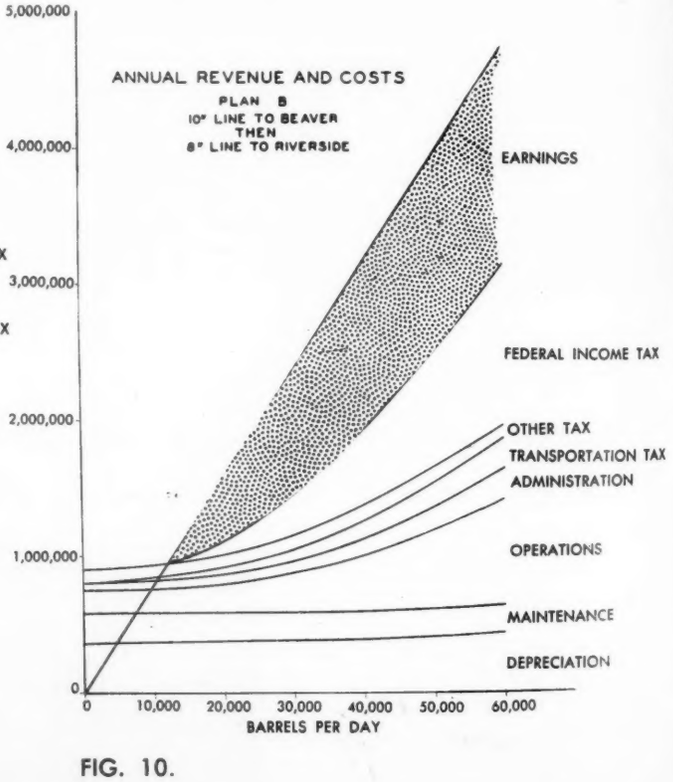
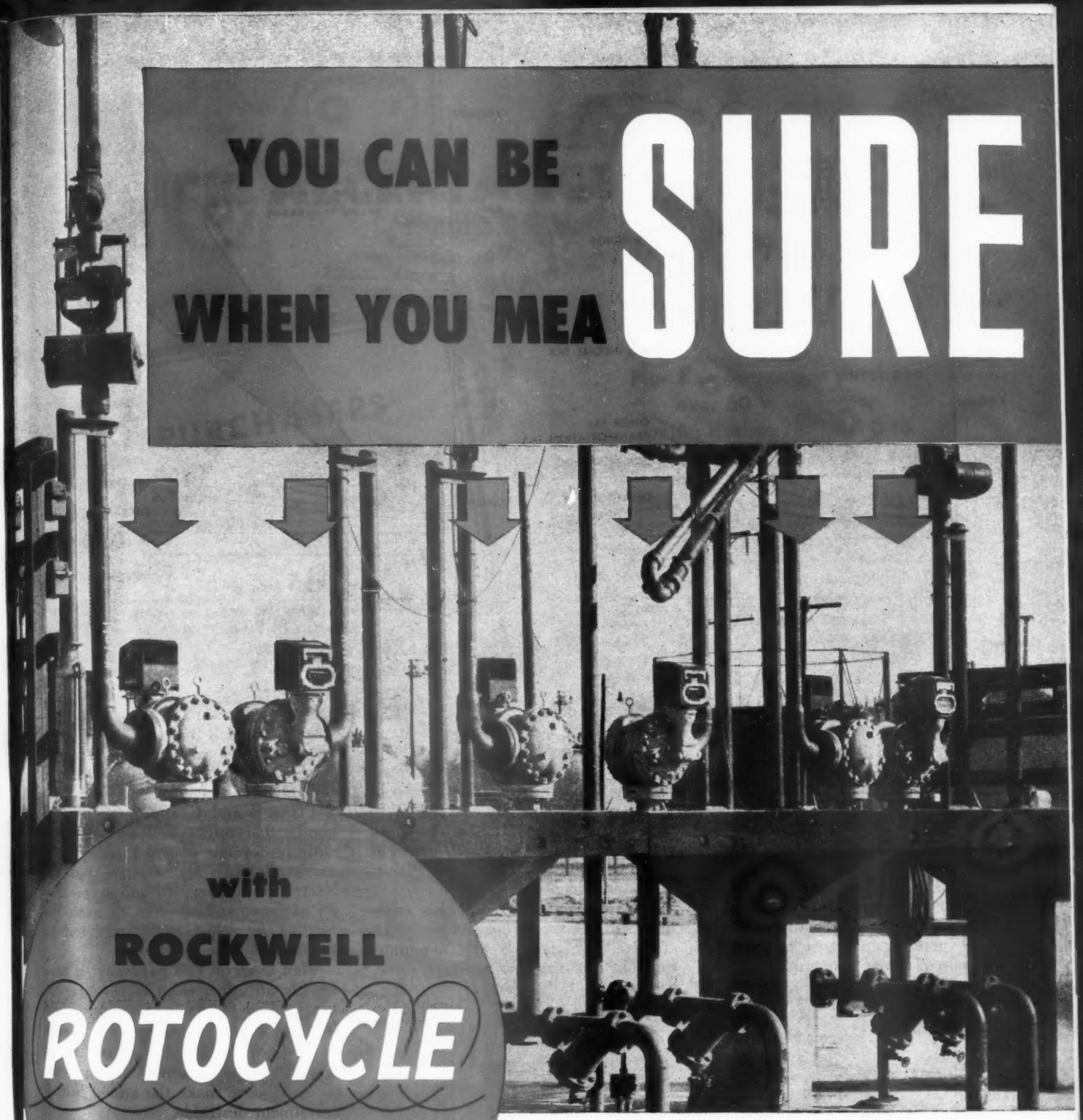


FIG. 10.



When you install Rotocycle meters on your pipe line terminals you gain many advantages besides the convenience of meter control. You get the proven accuracy of an all-revolving positive displacement measuring unit. You get speed in loading that results from a free running mechanism of extra large capacity. You get a durable construction that will give years of service.

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Rotocycle meters are made in types and sizes for every requirement—bulk station, tank truck, or pipe line. Write for literature.

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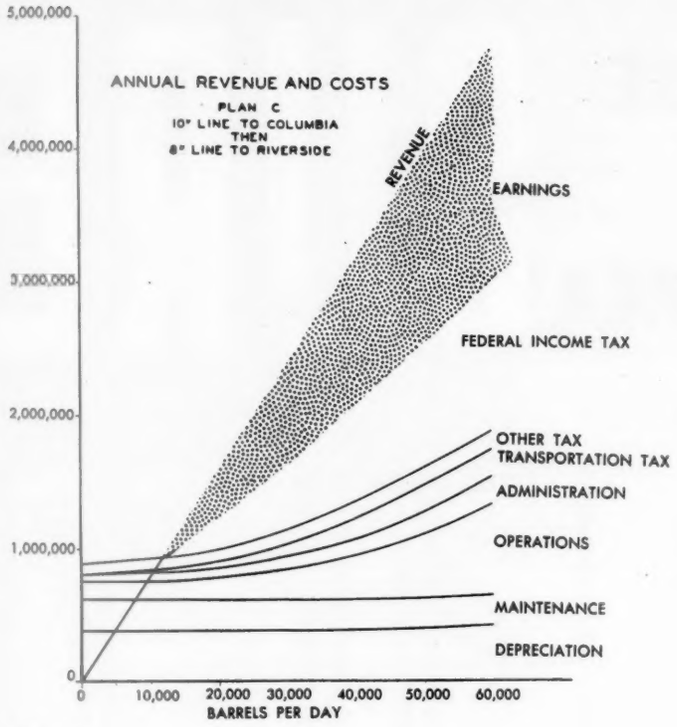

FIG. 11

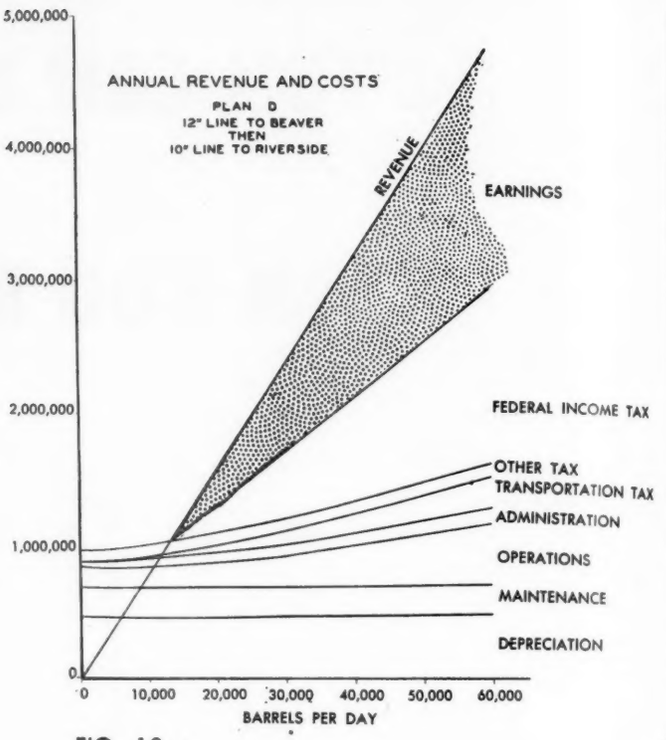

FIG. 12.

see in Figs. 9, 10, 11, and 12 the costs of all 4 of the proposed schemes. You will note that at 30,000 bbl per day Plan A returns $630,000; Plan B, $708,000; Plan C, $716,000; and Plan D, the 12-in. and 10-in. line, $681,000. At 60,000 bbl per day, however, the more large size pipe the better, for Plan A returns $1,077,000; Plan B, $1,614,000; Plan C, $1,708,000; and Plan D, $1,842,000.

Although we have included the effect of increased plant investment on the Depreciation Account, still we have not applied the real yardstick of our economic system — per cent return on the invested capital.

Figs. 13 and 14 show that our least possible investment would, of course, be for an 8-in. line, but that the addition of pumping stations would cause this to surpass the cost of Plan B at about 51,000 bbl per day, and Plan C at 55,000 bbl per day.

The per cent return on this minimum investment would not be so attractive, for right in the neighborhood of our expected starting value, the per cent return of Plan A falls below that of Plan B and C, and is below even the most expensive plan by the time the volume reaches 40,000 bbl per day.

Plans B and C appear to offer a choice that might well be based on entirely foreign considerations, such as, availability and relative cost of electric power, terrain and accessibility of pump station sites, or even the method by which it is expected to finance the entire project.

Plan D serves two purposes: It represents an upper limit to the reasoning applied to this entire study, and it gives an indication of what could be realized should the possibility of new shippers and increased volume be so great as to make the added initial investment desirable.

So, we see it has been possible to put our proposed line into a series of graphs that help us to see the relative financial merits of the various schemes of design and operation. By this means we have eliminated the first plan, offered a choice of two other plans that will produce practically the same percentage return over the foreseeable future, and indicated a fourth plan that may warrant consideration.

The actual selection of the final scheme remains a matter calling for the exercise of the faculty of business judgment, which some men have and some men don't. Unfortunately, we don't seem to be able to put business judgment on a graph. * * *

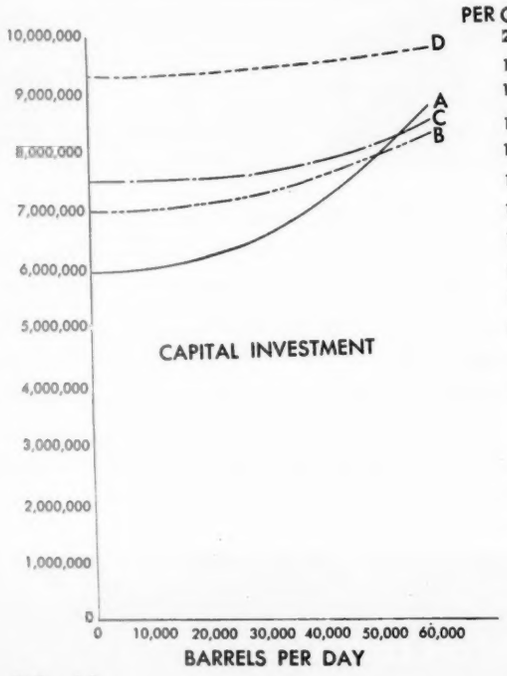

FIG. 13.

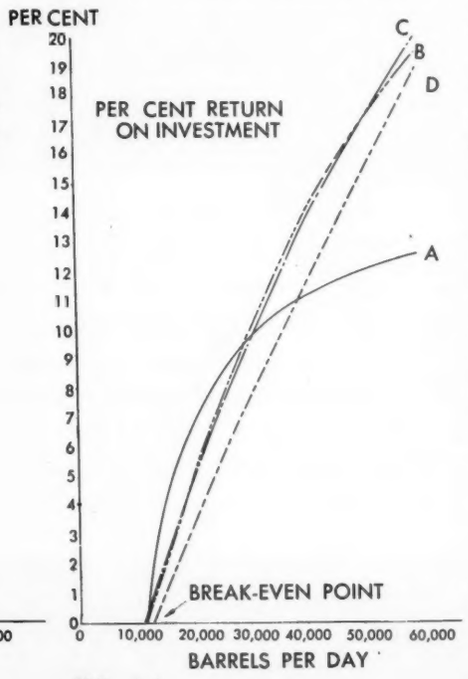

FIG. 14.

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- **All parts were carbon-free,** demonstrating the marked superiority of Worthington uniflo scavenging over conventional loop scavenging for reducing wear.
- **Pistons and liners were still well within shop tolerances,** and the high polish on the entire liner surfaces indicated A-1 operating condition.
- Rings showed minimum wear, with tool marks still visible.
- Bearings were all in perfect condition.

A Success From The Start

Shop tests had already proved TYPE UTC-16's more thorough scavenging, and perfect combustion. Now, this far more conclusive field test proved the ability to assure these benefits over a long, trouble-free service life. And a steadily growing list of purchasers has established TYPE UTC-16 as a real history-maker in the development of more efficient, more economical gas transmission.

Why not investigate the many advantages of joining this list? Get the whole story that proves *there's more worth in Worthington* from our nearest District Office. Or write to *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.*

WORTHINGTON

EK-0-3

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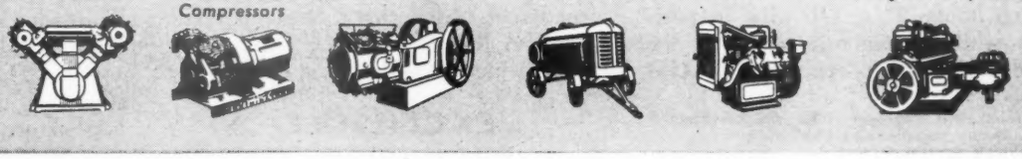

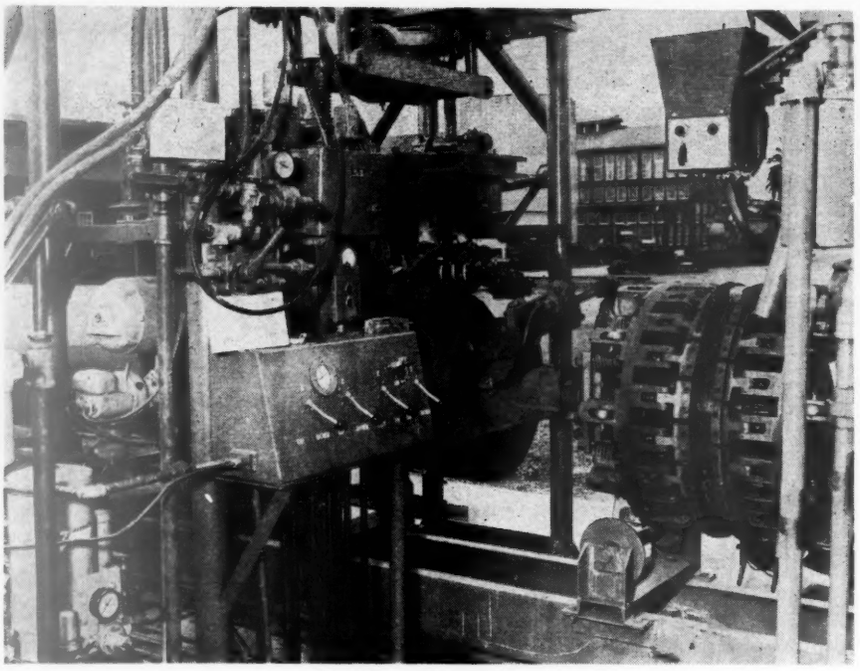

FIG. 1. The completed clamp and controls installed with customer's equipment ready for welding. The air powered hydraulic pump is at the lower left, the control cabinet just above and to the right of the pump, and the clamp is to the far right.

Machine Welding in the Field

Internal clamp for large diameter pipe speeds welding, reduces rod waste, offsets human factor.

WILLIAM R. HARPER*

OF the many problems confronting the oil field pipe line contractor, the high cost of manually welding the lengths of pipe together in the field probably holds the spotlight. Since this welding is done in the open, in all kinds of weather, and human nature being an important element in obtaining welds that will pass the pipe line welding code, the cost per girth weld due to waste of welding rod, considerable chipping out of welds and re-welding, is greatly increased.

The purpose of the internal clamp discussed in this article is to provide a means of machine welding these girth joints to offset the human element in obtaining good welds, reduce the waste of welding rod, and to speed up the welding.

This design consists of an internal clamp for use with machine welders, which holds 30-in. OD pipe in position while being rotated under the welding head for circumferential welding of joints connecting 30-ft lengths of pipe. The clamp provides internal clamping and rounding out of the connecting ends of each of two lengths of pipe, pulling the two lengths tightly together for welding, and also provides an internal water-cooled copper back-up shoe for preventing blowtroughs. First consideration was given to ruggedness and dependability, as these clamps were to be first used on the Arabian desert with predominantly native labor. The final design, as now in use, is shown in the accompanying figures.

The internal expanding clamp was mounted on the end of a 32-ft cantilever boom, centered under the welding head and directly over a narrow gage track. The hydraulic pressure lines and turbine for the back-up shoe cooling water are routed from the control panel to the clamp through this boom. A length of pipe is loaded on a car, which is pulled by a cable system powered by an air motor to the clamp. When the first length of pipe is placed on the clamp, the car is lowered a few inches on a section of the rail, which can be raised and lowered by a system of pneumatic cylinders. When this length of pipe is secured by the clamp, the car is raised to the track level and taken back to the loading ramp for the next length of pipe. The second length of pipe is loaded on the car, taken to the clamp and secured, and the car moved back to the loading ramp.

All operations of the clamp are controlled by an hydraulic system, consisting of an air-powered reciprocating force pump and an accumulator for dampening pump impulses. A control panel, shown in Fig. 1, contains the necessary 4-way valves for controlling the operation of clamps, the axial thrust cylinder, and the raising and lowering of the back-up shoe; an hydraulic pressure gage and a shut-off valve for the back-up shoe cooling water. A mixture of water and soluble oil is used as the operating medium.

In operation, the pressure fluid is introduced to the first clamp wheel cylinder "A," holding the first length of pipe in position. This pressure is great enough to round-out any slight irregularities in the pipe, which is necessary to obtain a good weld. When the second length of pipe is brought into position, pressure is admitted to the second clamp wheel cylinder "B," gripping and rounding out the pipe. The two lengths of pipe are then pulled tightly together by the thrust cylinder, "C," in the main tube and the back-up shoe, item 16 in Fig. 4, raised to operating position, bearing against the inside of the pipe at the joint and directly under the welding head. The two lengths of pipe are rotated during the welding and cooling water is circulated through the back-up shoe to prevent its overheating.

After the welding is completed the back-up shoe is lowered, dogs on both clamp wheels retracted, and the axial thrust cylinder returned to the relaxed position. The total stroke of this cylinder is $\frac{3}{4}$ in.

As shown in Sectional View A-A,

*Mechanical Engineer, Westinghouse Electric Corporation, Sunnyvale, California.

EXCLUSIVE

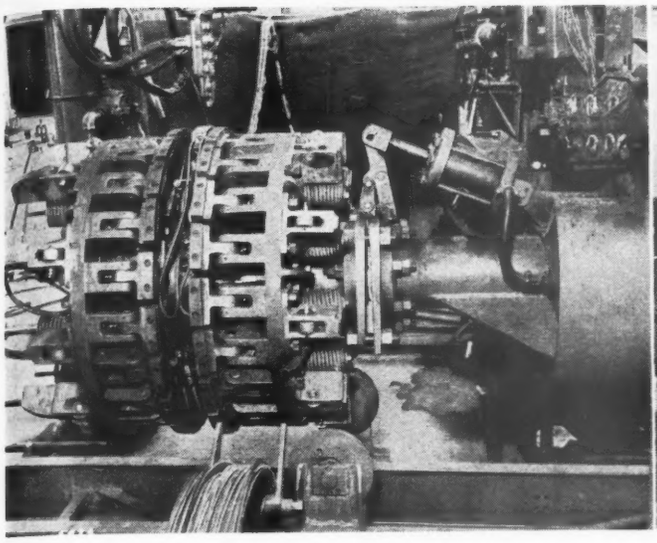

FIG. 2. This photo shows a close-up of the welding clamp. The copper back-up shoe can be seen between the two rows of grooved clamp shoes directly under the welding head.

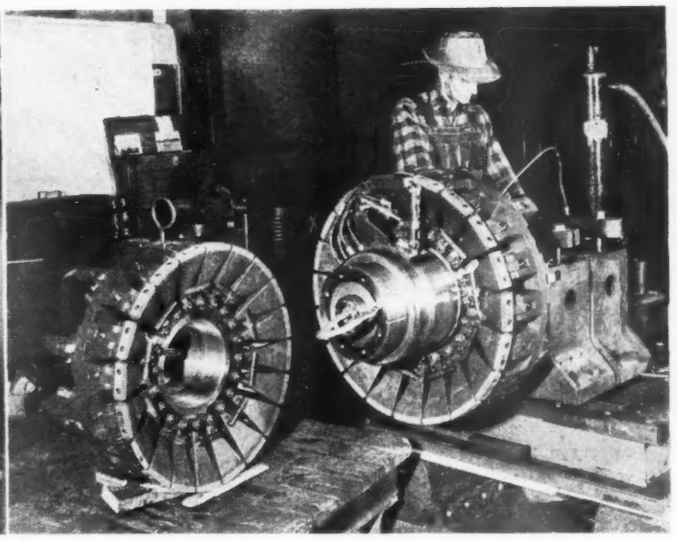

FIG. 3. This photo shows one clamp wheel and the back-up shoe assembled on the main tube and the other clamp wheel ready to be installed.

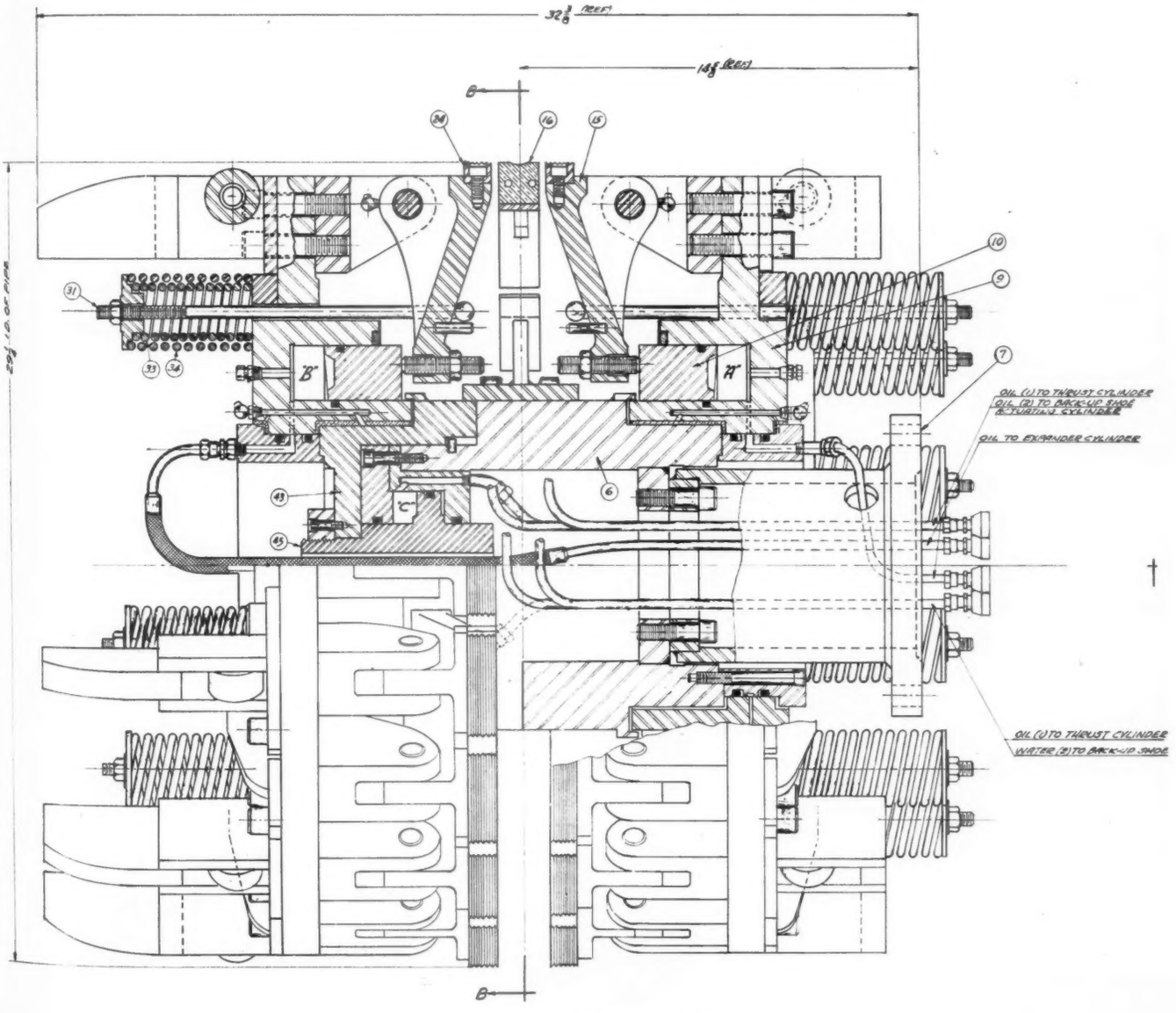
OIL (1) TO THRUST CYLINDER
OIL (2) TO BACK-UP SHOE ACTUATING CYLINDER
OIL TO EXPANDER CYLINDER
OIL (1) TO THRUST CYLINDER
WATER (2) TO BACK-UP SHOE

FIG. 4. Sectional view A-A.

(Fig. 4), the clamp proper consists principally of a main control tube, item 6, with flange, item 7, for connecting to the cantilever boom; an hydraulically raised and lowered copper back-up shoe, item 16, which is water-cooled; two clamp dog wheels, item 9, rotating on bronze grease lubricated bushings, each wheel having 20 radial clamp dogs, item 15, with replaceable hardened and serrated faces, item 24, the clamp dogs on each wheel being actuated by one common piston, item 10, and which are returned to the relaxed position by nested springs, items 33 and 34, and T-bars, item 31, and an axial thrust cylinder and piston arrangement, item 43 and 45, which are used for pulling the two lengths of pipe tightly together. This axial thrust cylinder is shown in operating position. At the end of the welding operation the thrust cylinder and its attached clamp wheel are moved 3/4 in. to the left of the position shown.

Sectional View B-B (Fig. 5) shows in detail the copper back-up shoe and its elevating mechanism. One end of the back-up shoe carrier is pivoted to the mounting, the other end being pivoted at the upper end of an enclosed spring carrier, which has a roller at its lower end. This roller rides on an inclined ramp. A small hydraulic cylinder pulls this roller end up the ramp, pushing the back-up shoe into contact with the inside of the pipe. The spring is utilized to provide both the necessary pressure between the back-up shoe and the pipe and also to allow the shoe to follow the small irregularities of the pipe without dragging too heavily against high spots, such as the longitudinal weld bead inside the pipe. The back-up shoe has a hardened tool steel insert in its leading edge.

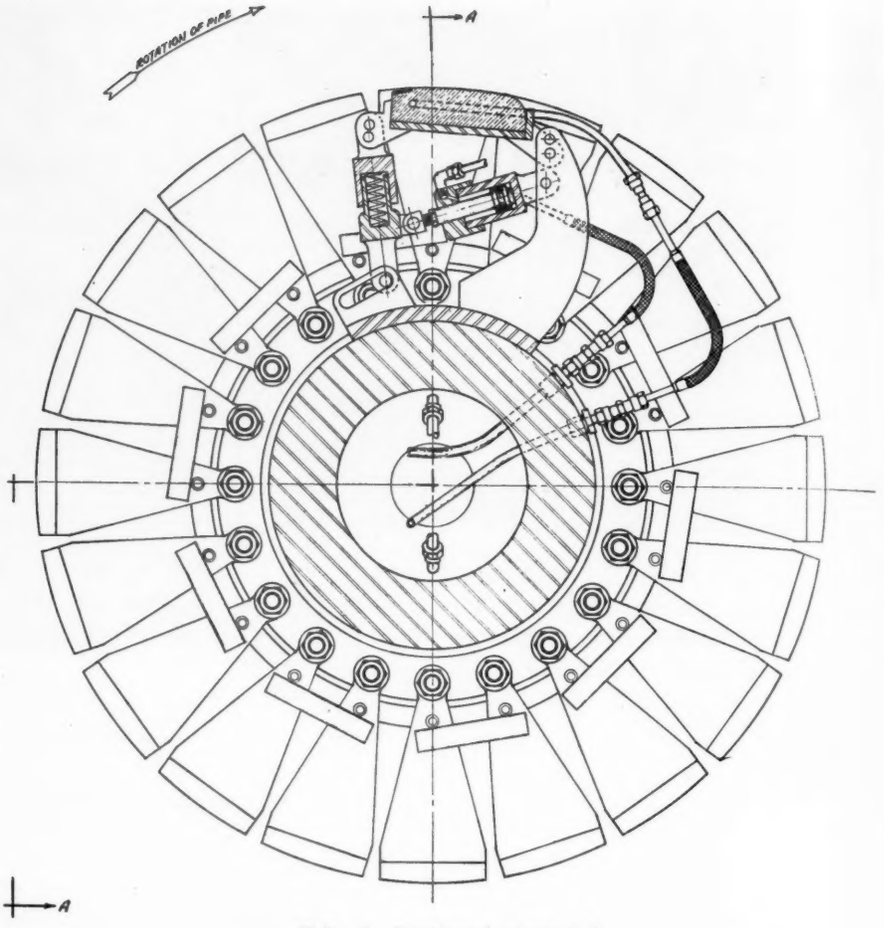

FIG. 5. Sectional view B-B.

Considerable experimentation was required in the design of the back-up shoe, as there were no data available on the depth of groove necessary, the pressure of the shoe against the pipe, the optimum temperature of the back-up shoe, or the length of contact of the shoe leading and following the point of contact of the electrode.

Pressure sealing throughout is with Neoprene "O" rings, which have given good service under conditions of fairly high pressure and desert temperatures. * * *

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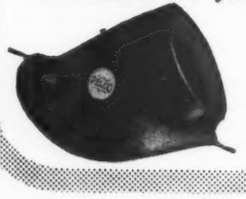

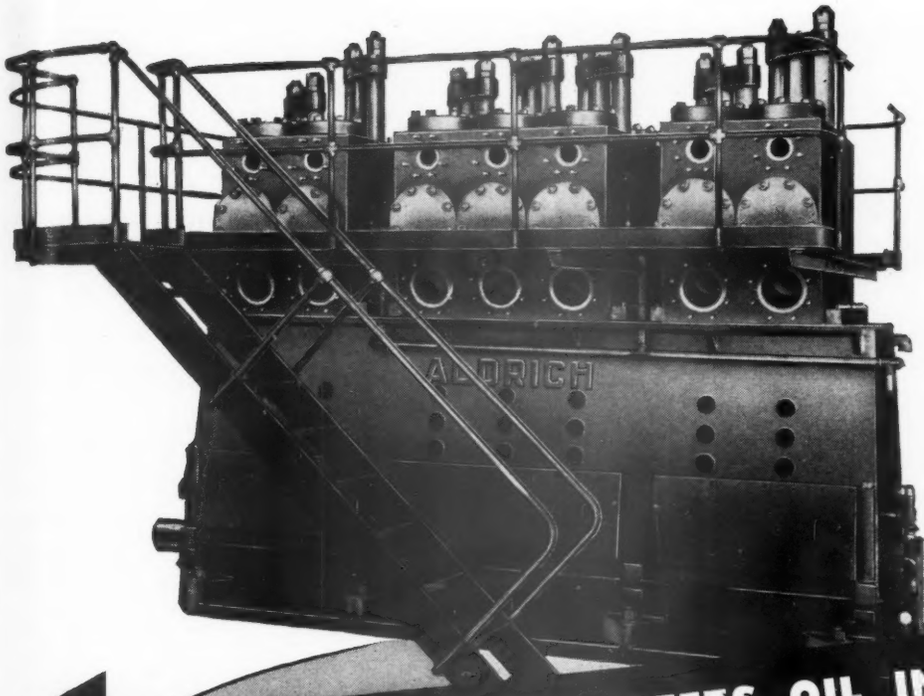

This 8½" stroke, 1900 hp Inverted Septuplex Pump was made for crude oil pipe line service and is designed for direct coupling to engine, motor or speed reducer. Illustration shows pump without suction and discharge manifolds. Request Data Sheet 67.

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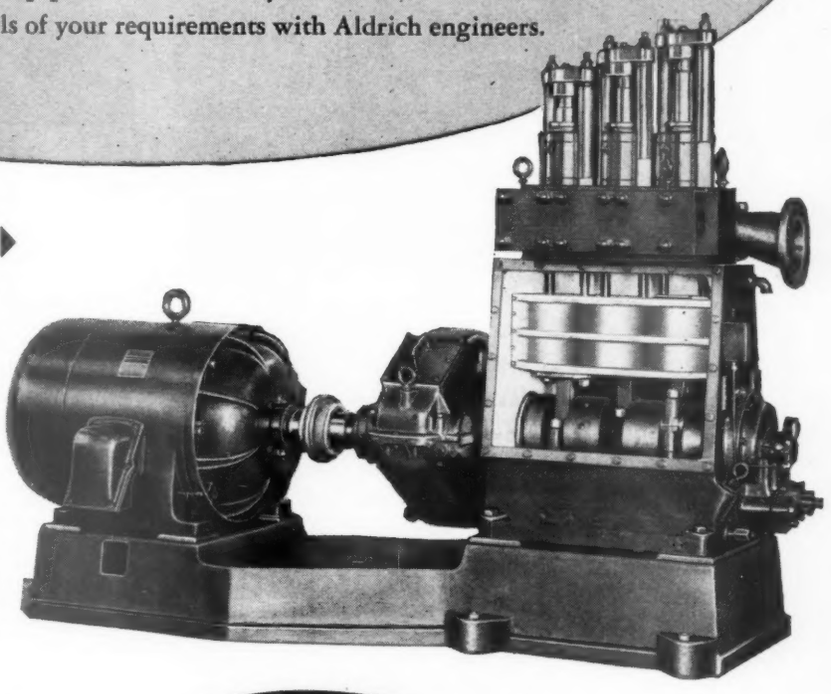

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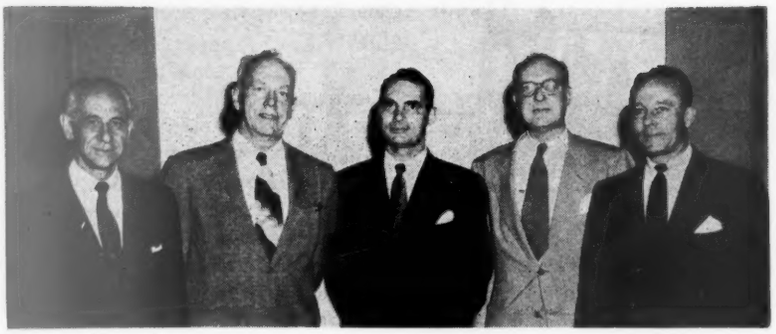
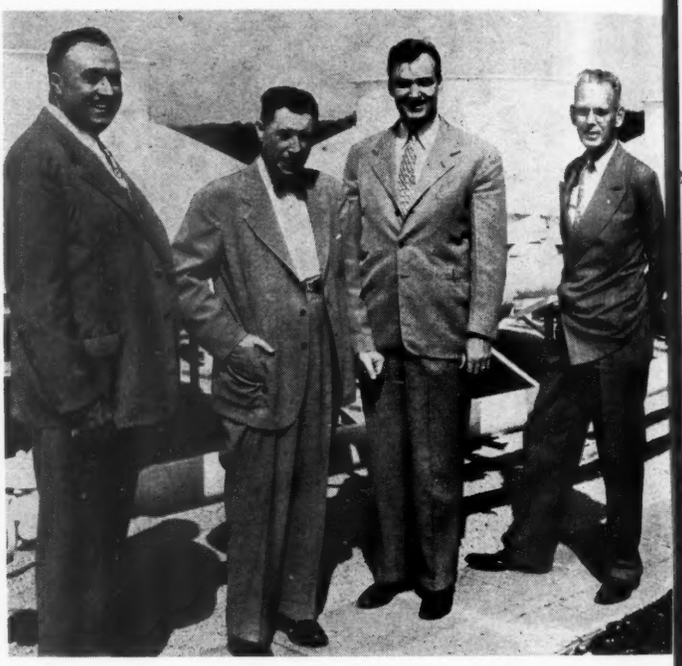
Pictorial

API Pipe Line Conference. The photographs in this month's "Pictorial" were taken at the API Products Pipe Line Technology Conference in St. Louis and during tour of Shell pump stations.



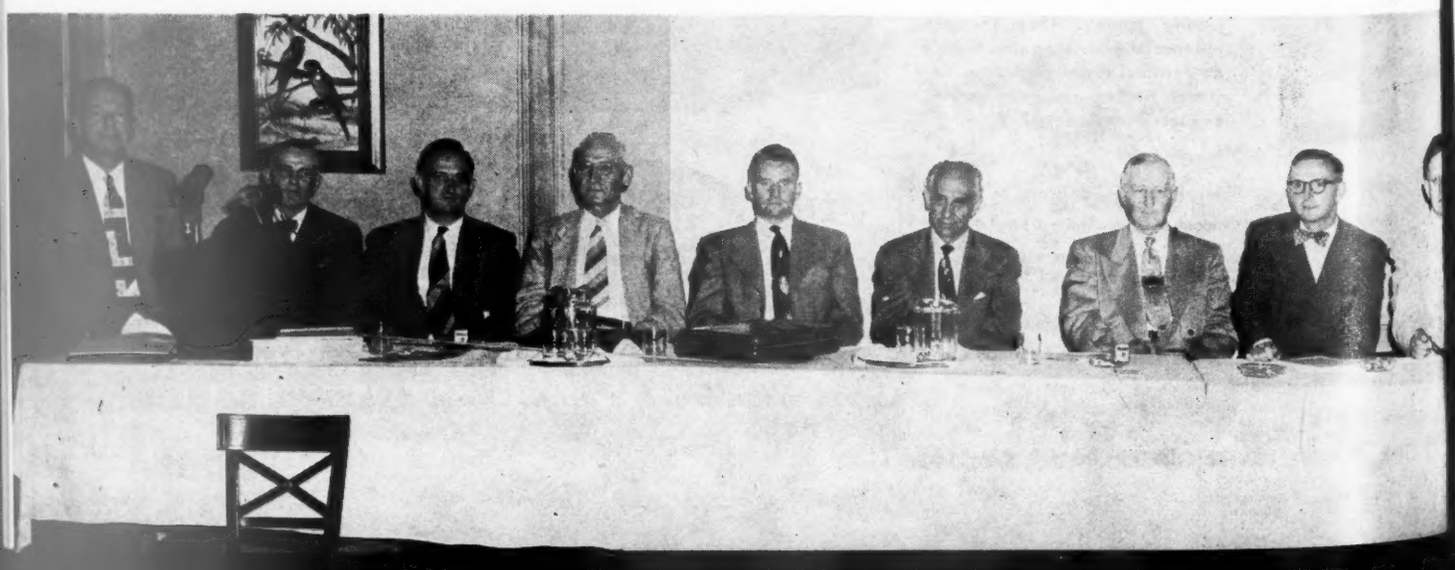
Officials in charge of arranging the conference: S. S. Smith, Shell Oil Company; John W. deGroot, Tuscarora Oil Company, Ltd., who presided; H. E. Fisher, Standard Oil Company (Indiana); R. H. Lynch, Keystone Pipe Line Company, and H. E. Dischinger, Shell Oil Company, acting secretary of committee.

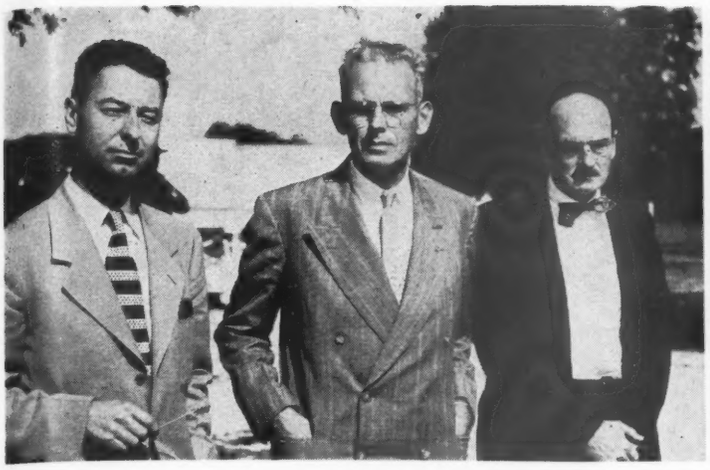


George Weber, Detroit Southern Pipe Line Company; J. W. Meehan, Pure Transportation Company; Irvin Tietze, Phillips Petroleum Company, and G. T. Jennings, Phillips.

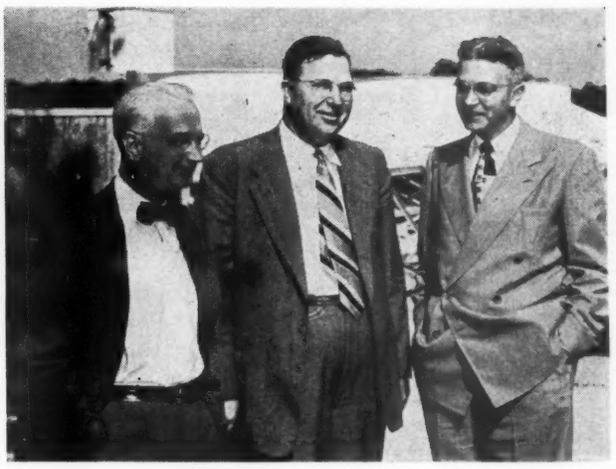
Earl Unruh, Carl Feldman, David Kauffman, L. B. Moon, R. F. Moore, and Charles Weidlein, all of Sinclair Refining Company, Pipe Line Department.

Panel members for forum session: John W. deGroot, Tuscarora Oil Company, Ltd., presiding; L. S. Wrightsman, Humble Pipe Line Company; C. C. Keane, Great Lakes Pipe Line Company; W. G. Hortsman, Plantation Pipe Line Company; D. C. Glass, The Pure Oil Company; S. S. Smith, Shell Oil Company; Ray T. Scott, Standard Oil Company (Indiana); L. A. Baxter and E. B. Dunn, Keystone Pipe Line Company.

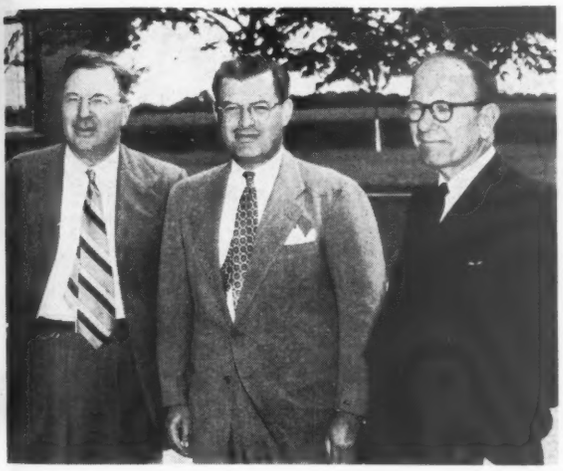




These men also were speakers: K. T. Feldman, Sinclair Refining Company; G. T. Jennings, Phillips Petroleum Company, and T. L. Opie, Socony-Vacuum Oil Company.

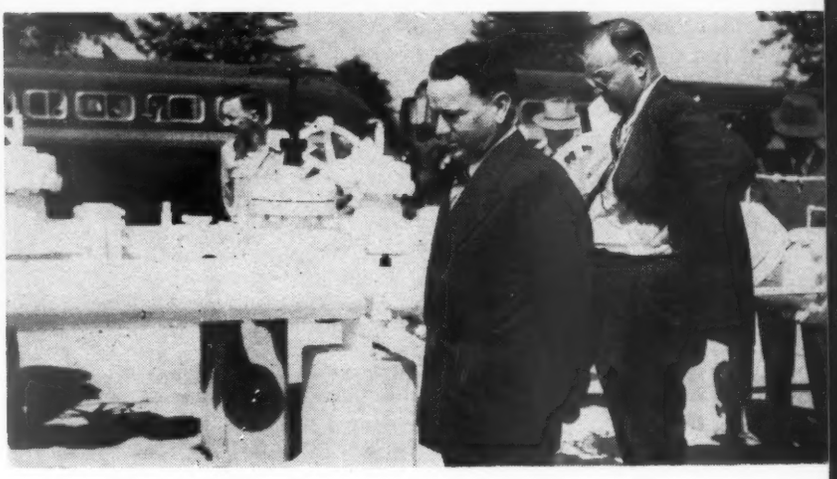


Art Kerr of Pittsburgh Equitable Meter Company, Ernie Liggett of Johns-Manville, and Doug Rankin of Standard Oil Company (Indiana).



Ernie Liggett, Clark Bailey, and L. A. Baldwin, all of Johns-Manville.

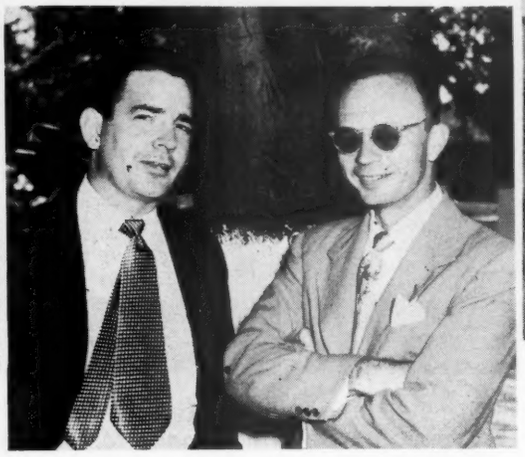
F. C. Whiteside of Continental Pipe Line Company and L. R. Dickinson of Socony-Vacuum Oil Company inspect equipment at Shell's Vandalia, Illinois, station.



These men were speakers: E. B. Dunn, Keystone Pipe Line Company; Jack P. Hedlin, Standard Oil Company (Indiana); C. Alan McCutcheon, J. E. Jednacz, and R. F. Hadley, all of Susquehanna Pipe Line Company; S. S. Smith, Shell Oil Company; F. O. Stivers, Jr., Humble Pipe Line Company; Norris Plant, Shell, and R. H. Lynch, Keystone.

L. F. Scherer, The Texas Pipe Line Company, with Texas grape given him during station tour.

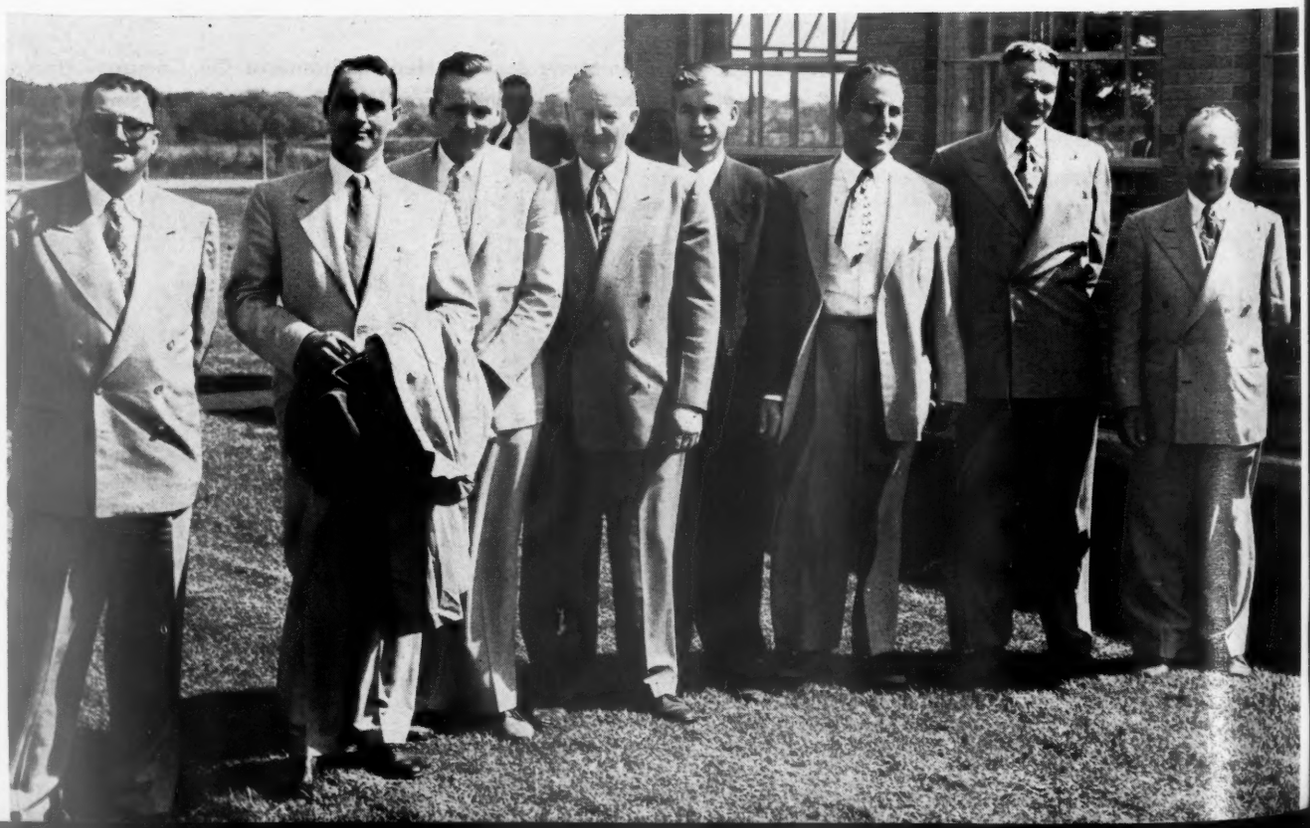
Dave Roach, Phillips Petroleum Company, and Dick Ellis, Sunray Oil Company.



H. M. Stevenson, Humble Pipe Line Company, and N. W. Hartz, Mines Safety Appliances Company.

Herb Fisher, Standard (Indiana); John Norton, Magnolia Pipe Line Company; G. A. Lundberg and J. J. Harris, also of Magnolia, and Ernie Slade, Service Pipe Line Company.

A Standard Oil Company (Indiana) group that includes D. L. Rankin, H. E. Fisher, R. H. Starrett, J. L. Ashworth, A. F. Smith, John Graper, Jack Hedlin, and R. T. Scott.



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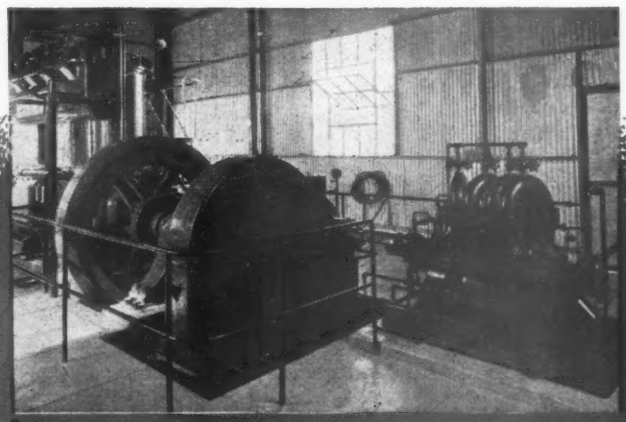

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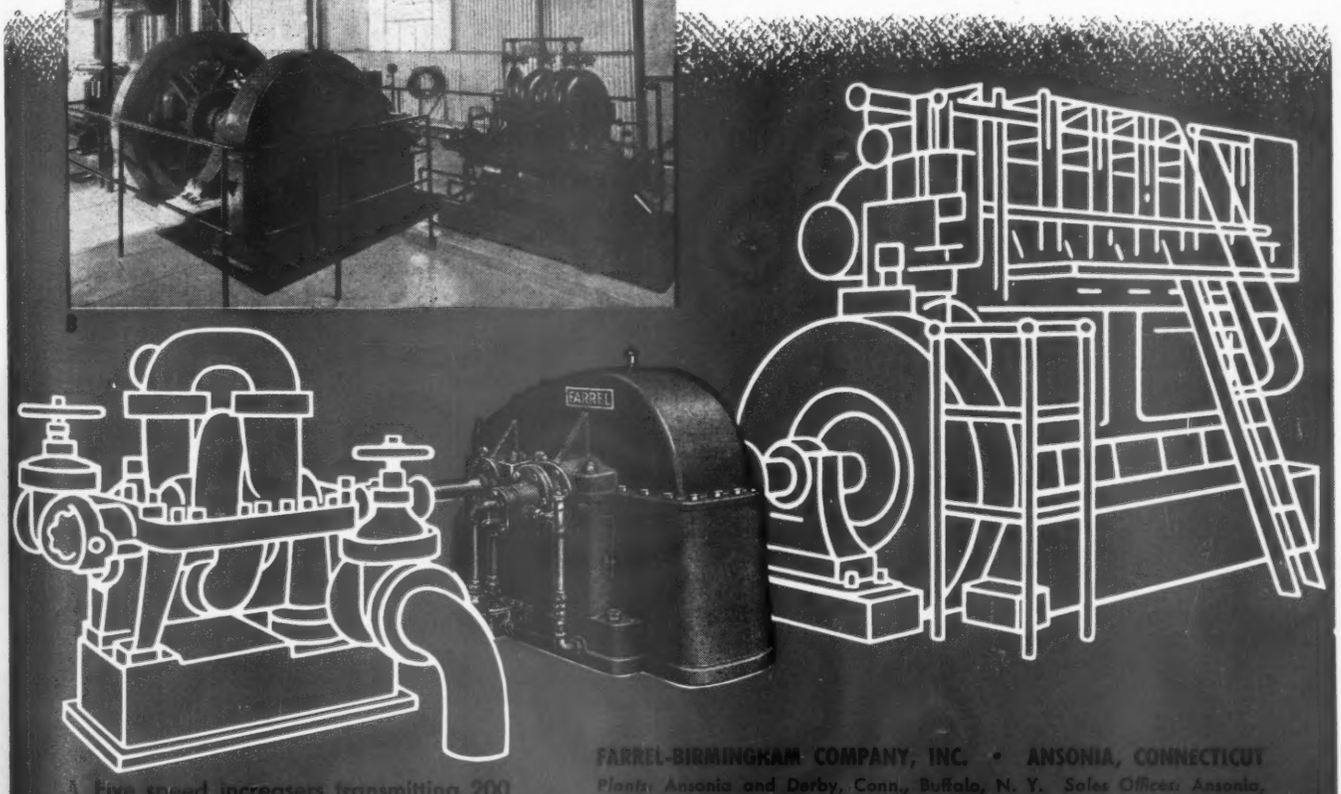

A Five speed increasers transmitting 200 HP with a 10½ to 1 step-up, driving high pressure pipe line centrifugal pumps. This company has over sixty similar units in operation.

B Farrel unit transmitting 250 HP with a 12 to 1 step-up from a gas engine to a centrifugal pump. This unit was installed in 1932, and is still in operation.

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NEWS

Salt Lake Pipe Line System is Completed

Completion of its $12,000,000, 566-mile oil products pipe line from Salt Lake City, Utah, to Pasco, Washington, has been announced by Standard Oil Company of California.

The line was constructed and will be operated by Salt Lake Pipe Line Company, a Standard subsidiary. First leg of the line, from Salt Lake to a point near Boise, Idaho, was completed in the fall of 1949, when winter weather halted further work. The rest of the line was completed this summer, with construction crews working between Pasco and Boise.

The 8-in. line has a capacity of 15,000 bbl a day, with one pumping station at Salt Lake and another at Boise. Capacity could be boosted to 21,000 bbl a day with installation of a third pumping station.

Products from Standard's new refinery at Salt Lake will be carried in the line to eight take-off points along its route, serving a large part of the Intermountain and northwest regions. Terminals have been installed at Ogden, Utah; Burley, Twin Falls, Boise and Fruitland, Idaho; Baker and Adams, Oregon, and at Pasco.

A newly developed chemical marker is utilized in operation of the line to determine the interface between products being carried. Instruments sensitive to the marker indicate the approach of an interface to each operating station.

Construction of the new pipe line was by Morrison-Knudsen Company, Inc., Macco Corporation, Bechtel Corporation, Pacific Pipeline and Engineers, Ltd., Grafe-Callahan and Oklahoma Contracting Companies, and Smith Contracting Corporation.

Buys Portsmouth Gas Stock

The Commonwealth Natural Gas Corporation has acquired approximately 99½ per cent of common stock of the Portsmouth Gas Company, which presently serves manufactured gas in the City of Portsmouth, Virginia, and in the counties immediately surrounding. Commonwealth will change over the appliances to the utilization of straight natural gas when such is made available in December of this year.

Officers of the new company are: Erick Larson, president; B. B. Ferguson, Jr., vice president; John B. Thorn, secretary; Chas. C. Drummond, treasurer, and Chester E. Starkey and Robert W. Johnson, assistant secretaries and treasurers.

TGT's Buffalo Line Nears Completion

With the bright colors of fall flecking the leaves and chill breezes blowing in from Lake Erie as reminders that winter comes early in northern Pennsylvania and eastern New York, two spreads of H. C. Price Company pipeliners are working feverishly to complete the Tennessee Gas Transmission Company's line into Buffalo.

Having helped finish a 220-mile section across Ohio in record time, spreads under the supervision of Abe Reutzel and Bob Shivel are now racing toward each other from opposite ends of the 153-mile Pennsylvania-New York portion of this 26-in. line.

Reutzel's gang, after closing out operations around Carrollton, Ohio, first set up headquarters at Sharon, then quickly moved to Corry, Pennsylvania, as the impetus of good weather and level terrain carried them northward. Shivel's crew, retarded by heavy rain and faced with a much longer move, got located a few weeks later at Dunkirk, on Lake Erie.

Both spreads were held up for some time by a delay in the shipment of line pipe. A brief railroad strike also interfered in operations; however, each crew is now working at top speed, determined to outdistance Old Man Winter and bring the comforting warmth of southern gas to residents along the line before bad weather.

Rate Increase Made Subject To Refund

A proposed rate increase by El Paso Natural Gas Company, of El Paso, Texas, for wholesale natural gas service to Southern California Gas Company and Southern Counties Gas Company of California, both of Los Angeles, California, became effective October 1.

The increase, amounting to about $2,465,000 annually, or 12 per cent, based on anticipated sales for the 12-month period ending April 30, 1951, was suspended by the FPC last April 24 pending hearing and decision on the question of the lawfulness of the proposed rates. Under the Natural Gas Act, if a suspension proceeding is not completed within 5 months of the effective date of suspension, the company may make the increased rate effective by filing an appropriate motion with the Commission. El Paso filed such a motion to make the increased rates effective as of October 1. Thus, since the proceeding was not concluded or a decision rendered in the case at the end of the five-month period, El Paso's schedules may now go into effect pending final decision by the Commission.

Tapline Ready To Carry Crude

Completion of the world's largest oil pipe line was announced recently by Trans-Arabian Pipe Line Company, which will operate the line for Arabian American Oil Company. The 1068-mile line runs from rich American-owned oil fields to the Persian Gulf in Saudi-Arabia to the ancient town of Sidon on the Mediterranean coast. It was built to eliminate a 7000-mile tanker haul through the Suez Canal.

With completion of the pumping stations, it is expected to begin loading tankers anchored off Sidon within 2 months. The American-built line cost an estimated $250,000,000 and took 323,000 tons of steel.

Northeastern, Algonquin File New Proposals

Northeastern Gas Transmission Company and Algonquin Gas Transmission Company, both of Boston, Massachusetts, have filed with the Federal Power Commission separate proposals to serve the entire New England area with natural gas. Algonquin, in addition, submitted an alternative plan for two-system service in the New England area. This proposed project involves a division of the markets proposed to be served by Algonquin and Northeastern.

Both companies filed their new proposals following the FPC's issuance of an opinion October 4 in which it was found that service as previously proposed by the two companies, which are competing for the New England market, does not meet the test of public convenience and necessity. The Commission called for the companies to present a proposal that will meet the public demand and need for natural gas in New England.

Northeastern's new proposal asks the FPC to authorize it to build a basic pipe line system capable of expansion to supply the requirements of the entire New England area. Northeastern claims that the substitution of 114 miles of 24-in. line for the equivalent miles of 20-in. line would result in a basic system capable of expansion to supply 485,000,000 cu ft of natural gas per day.

Algonquin, in submitting its alternate proposal, asserted that the evidence of record shows that its system has been designed and planned so that it can readily and easily be extended in several ways to serve substantially the whole New England market. Algonquin also stated its willingness to purchase natural gas from any of the 3 wholesale companies seeking to supply the requirements of that area.

California Gas Loop Placed in Operation

Completed well ahead of schedule, the 82-mile Texas pipe line loop from Whitewater to Puente has been put into operation by the Southern California Gas Company and the Southern Counties Gas Company.

Also completed and placed in operation is the tenth compressor unit at the Blythe compressor station.

Construction of the 82-mile loop line makes possible an increase in delivery capacity of the Texas-California pipe line from 305,000,000 to 405,000,000 cu ft a day, at the same time restoring the 50,000,000 cu ft of line storage capacity originally built into the line, but lost when delivery rates exceeded 305,000,000 cu ft.

Addition of the new 1760-hp, 8-cylinder Clark compressor at Blythe will now provide standby capacity for overhauls in addition to the former 405,000,000 cu ft a day capacity of the compressor station.

FPC Denies Request of Michigan Company

The Federal Power Commission has denied, without prejudice, the application of Southeastern Michigan Gas Company, of Chicago, Illinois, for an FPC order directing Panhandle Eastern Pipe Line Company, of Kansas City, Missouri, to supply natural gas for resale in the southeastern Michigan area.

The commission's order provided that Southeastern may continue to participate in the hearings now in progress before an FPC Presiding Examiner with respect to an equitable apportionment of gas that will become available from the Panhandle system by reason of the construction of the Trunkline Gas Supply Company facilities.

Although the commission found that there is need for gas service in the area proposed to be served by Southeastern, it said that the company has not shown that it can render adequate service. The FPC said that Southeastern's proposed project is not economically feasible unless natural gas in volumes ranging up to 15,000,000 cu ft a day is available. There is no showing, the commission continued, that Panhandle can supply that volume to Southeastern without impairing adequate service to its existing customers.

Southeastern is proposing to build a 55-mile pipe line that would carry natural gas for the first time to consumers in Port Huron, Marysville, St. Clair, and the contiguous area in Michigan.

FPC Consolidates Hearings On United Gas Applications

Further hearings on two applications of United Gas Pipe Line Company, of Shreveport, Louisiana, have been consolidated by the Federal Power Commission beginning November 13 in Washington, D. C. The Commission separated one of the applications from another proceeding at the same time scheduled it for hearing with the second application, hearings on which were recessed September 14 to reconvene November 13. The latter application, filed last July 24, involves a proposal by United to build about 1005 miles of new line in Texas, Louisiana, and Mississippi.

In the proceeding from which its application was separated, United is proposing to supply natural gas to Atlantic Gulf Gas Company, an affiliate, also of Shreveport, for ultimate consumption in the Southeastern States. This proceeding, which also involves an application by Southern Natural Gas Company, of Birmingham, Alabama, was recently reopened by the FPC. Atlantic and Southern Natural both are proposing to serve substantially the same areas of Georgia, Florida, South Carolina, and Alabama.

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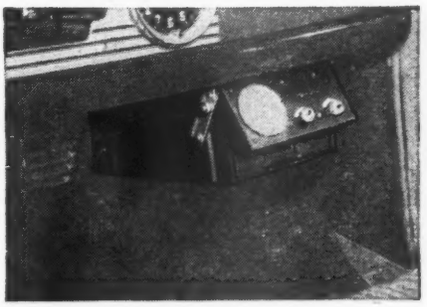

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NEWS

Gas Authorized For Arkansas, Kentucky Areas

Texas Gas Transmission Corporation, of Owensboro, Kentucky, has received temporary authorization from the Federal Power Commission to construct sales meter stations on its pipe line system to make natural gas available for distribution in communities in Arkansas and Kentucky.

Texas Gas will use the facilities to sell gas to the following for resale and distribution in the respective cities and their environs: The City of Carrollton, Kentucky, Louisville Gas and Electric Company, LaGrange, Kentucky, and Arkansas Power and Light Company, of Parkdale, Arkansas.

Estimated maximum daily demand is 1,321,000 cu ft for Carrollton; 470,000 cu ft for LaGrange, and 170,000 cu ft for Parkdale.

New Application Process For Hevicote

The H. C. Price Company Somastic division plant at Philadelphia has recently developed a horizontal method for the application of Hevicote to the exterior surface of line pipe in order to give it a negative buoyancy for marshy areas and river crossings. This new method is a departure from the process used at the company's Harvey, Louisiana, installation where Hevicote is applied with the pipe in a vertical position.

At Philadelphia, no reinforcing wire is used and the Hevicote is applied directly to Somastic-coated pipe. The asbestos fiber within the Somastic mix serves as a necessary binder for the concrete.

Amended Uniform System of Accounts Accepted

The Federal Power Commission has amended its Uniform System of Accounts for Natural Gas Companies to incorporate changes indicated by developments in the natural gas industry since the adoption in 1939 of the Uniform System of Accounts and by the experience of the FPC over the last 10 years. The changes will become effective January 1, 1951.

The amendments change the Uniform System of Accounts principally: (1) By making provision for an accounting for inventories of natural gas stored underground, and for account classifications for storage plant and expenses; (2) by relocation and better accounting for products extraction operations, relocation from production expense of credits for gas used by the utility, and (3) by making other improvements in plant and expense classifications including the inclusion of exploration and development costs among production expenses.

The FPC issued a notice of the proposed rule making on May 15. Six written comments were received in response to the commission's invitation, contained in the notice, for data, views, and comments concerning the proposed amendments. In general, these comments, none of which were adverse, indicated acceptance of the amendments and contained a number of helpful suggestions for changing and clarifying the language of certain of the proposed amendments.

FPC Authorizes Increase Of Storage Capacity

The Federal Power Commission has authorized Hope Natural Gas Company, of Clarksburg, West Virginia, to construct pipe line facilities designed to increase natural gas deliveries into the company's Fink storage area in Lewis County.

The facilities, estimated to cost $790,000, include 19½ miles of 18-in. transmission line and will provide increased pipe line capacity into the storage area of approximately 100,000,000 cu ft of natural gas per day. The facilities will not be used to serve any new markets, Hope said, but will enable the company to render more adequate service.

Proposes Increase of Present System Capacity

Mississippi River Fuel Corporation, of St. Louis, Missouri, has applied to the Federal Power Commission for authority to install additional compressor units on its pipe line system in Arkansas and Missouri in order to increase the daily capacity of its transmission facilities to 435,000,000 cu ft of natural gas. Mississippi recently received temporary authorization from the FPC to increase its system capacity to 375,000,000 cu ft per day. The company proposes to install additional compressor units totaling 22,000 hp in 8 previously authorized compressor stations and 5500 hp in another 8 compressor stations and 5500 hp in a new station.

New York State Natural Asks Authority For Line

New York State Natural Gas Corporation, of New York City, has asked the Federal Power Commission for authority to construct approximately 44½ miles of pipe line to connect the Leidy gas field with the company's natural gas transmission system in Pennsylvania. Estimated cost of the construction is $1,582,708.

TGT Interim Rate Schedules Allowed

The Federal Power Commission has allowed rate schedules submitted by Tennessee Gas Transmission Company, of Houston, Texas, covering the company's Northern (Ohio and Pennsylvania) and New York rate zones, where it has not previously rendered natural gas service, and the transportation of gas to and for the account of The Manufacturers Light and Heat Company, to take effect on an interim basis.

The commission, however, rejected proposed service agreements under the schedules covering the Northern and New York rate zones because they depart from the standard form of service agreement provided in TGT's FPC Gas Tariff, Original Volume No. 1.

TGT submitted the rate schedules and service agreements in response to a rate condition included in a certificate issued to the company in July, 1949, authorizing a $90,000,000 expansion program designed to increase the capacity of Tennessee's system to more than a billion cubic feet per day. That authorization required Tennessee to submit rate schedules satisfactory to the FPC at least 60 days prior to the commencement of services.

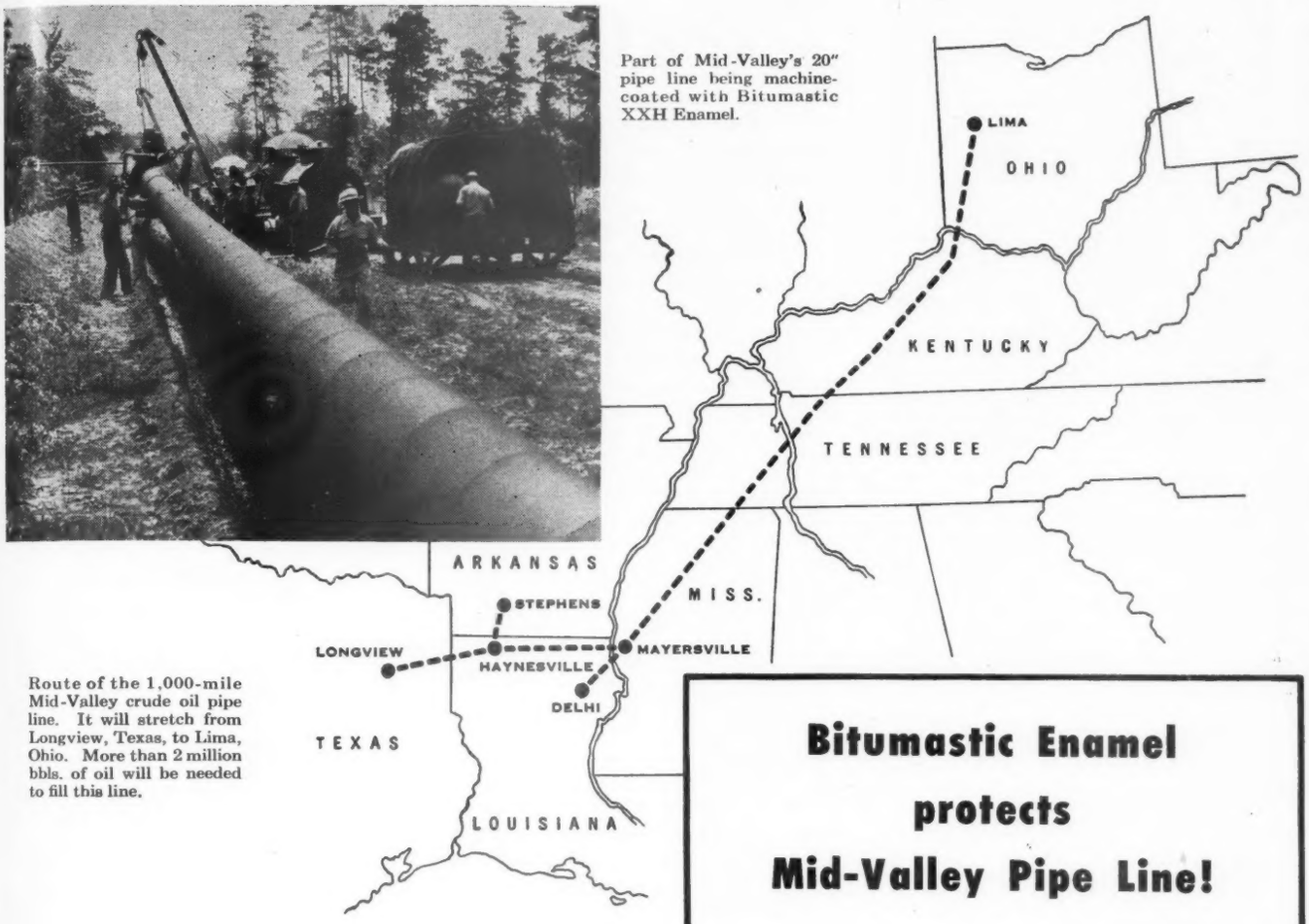
In allowing the rate schedules to take effect on an interim basis, the commission said that it was postponing determination of what constitutes "satisfactory schedules" until operating data can be obtained under the proposed schedules. The schedules are allowed to remain in effect up to December 1, 1951, and Tennessee is required to submit satisfactory schedules by October 31, 1951.

The rejected service agreements relate to East Ohio Gas Company, Equitable Gas Company, Pennsylvania Gas Company, Peoples Natural Gas Company, United Natural Gas Company, and Iroquois Gas Corporation.

The proposed schedules provide rates of $2.40 per 1000 cu ft per month demand charge and 17.2 cents per 1000 cu ft commodity charge in the Northern zone and $3.40 per 1000 cu ft per month demand charge and 21.2 cents per 1000 cu ft commodity charge in the New York zone.

The schedules embodied in the contract between TGT and Manufacturers provide for the delivery of 61,148,000 cu ft per day in West Virginia at a rate of $2 per month per 1000 cu ft demand charge and 7.83 cents per 1000 cu ft commodity charge, and delivery of 50,000,000 cu ft per day in the Northern zone at $2.40 per month per 1000 cu ft demand charge; 12.83 cents per 1000 commodity charge.

Part of Mid-Valley's 20" pipe line being machine-coated with Bitumastic XXH Enamel.



Route of the 1,000-mile Mid-Valley crude oil pipe line. It will stretch from Longview, Texas, to Lima, Ohio. More than 2 million bbls. of oil will be needed to fill this line.

Bitumastic Enamel protects Mid-Valley Pipe Line!

...ONE OF THE COUNTRY'S LARGEST AND LONGEST INTERSTATE COMMON CARRIER CRUDE LINES

THE Mid-Valley Pipe Line, that will stretch from Longview, Texas, to Lima, Ohio, will be an outstanding example of the engineering skill and ingenuity of pipeliners. Along the thousand-mile route, swamps, lakes and rivers, including the Ohio and the Mississippi, had to be "ditched" . . . rocky hills had to be crossed . . . forests had to be penetrated.

When pipe lines are laid under such rugged conditions, they *must* go down to stay . . . they *must* be fully protected against corrosion. And Koppers Coatings provide that protection.

Koppers Bitumastic® XXH Enamel was used to coat the line from Texas to Tennessee. In addition, three gathering lines have been protected by Bitumastic XXH Enamel.

Give *your* pipe lines the same effective protection by specifying "Koppers Bitumastic Enamel." Your Koppers representative will give you full details. Get in touch with him.

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PIPELINE PERSONALS

Volney H. Kyle, Jr.

Volney H. Kyle, Jr., has been elected vice president and manager of operations of the Michigan-Wisconsin Pipe Line Company. Kyle, as an engineer on the staff of Ford, Bacon and Davis, had the responsibility in the field for the construction of the Michigan-Wisconsin line, the recently completed 1500-mile system bringing natural gas from Texas to Michigan and Wisconsin. Michigan-Wisconsin is an affiliate of Michigan Consolidated Gas Company and the Milwaukee Gas Light Company in the American Natural Gas Company system.

Kyle is a pioneer in the natural gas transmission business, having assisted in the construction in 1927 of one of the first large-diameter cross-country high pressure natural gas pipe lines ever built. That was the line from the Monroe, Louisiana, natural gas fields to Baton Rouge and New Orleans, built by Ford, Bacon & Davis, for the Interstate Natural Gas Company, Inc. He spent 12 years in engineering studies and construction of pipe lines, other lines being the Colorado Interstate Gas Company line from Amarillo, Texas to Denver, Colorado, and the Southern Natural Gas Company's line from Monroe, Louisiana, to Atlanta, Georgia. He has been with Michigan-Wisconsin since January 1, 1950.

Kyle majored in mechanical engineering at Tulane University. From 1922 to 1924 he was employed in the engineering department of the Frisco lines. He spent the following 2 years with the Illinois Division of Highways. After employment for 3 years with Ford, Bacon and Davis, he joined the Highway Department of the State of Louisiana where he remained from 1930 to 1937.

Horace E. White has become acting assistant area superintendent of the West Texas area with headquarters at Colorado City, as a part of the additional personnel changes that have been announced by Shell Pipe Line Corporation to relieve employees assisting Shell Caribbean Petroleum Company build a pipe line in Venezuela. White relieves **James K. Alfred,** who moves to Houston as operations engineer. White will be replaced by **Joseph E. Mims** as acting division superintendent, Ozark Pipe Line System, headquartering at Springfield, Missouri.

White has been with Shell for more than 15 years, beginning as a field gager at Roberts field in West Texas. He was West Texas area safety engineer in 1942 and moved to Houston in 1946 as assistant to area superintendent, Texas-Gulf area. Before his move to Colorado City, he was division superintendent, Ozark Pipe Line System at Springfield.

Alfred also has more than 15 years' service with the company, beginning at Cushing, Oklahoma, in 1935. He was made West Texas area engineer at Colorado City in 1941. He served on two occasions as acting assistant area superintendent, West Texas, his position prior to his move to Houston.

Mims has more than 8 years with Shell Pipe Line, beginning as a junior draftsman at Houston. He was made engineer at Houston in 1947 and then moved to Springfield as division engineer on the Ozark System.

Charles R. Perkins has been elected secretary and treasurer of Mid-Valley Pipeline Company it is announced at Longview, Texas, by **E. F. Morrill,** president of Mid-Valley.

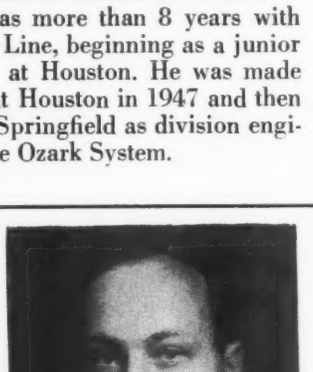
Perkins has been office manager of Sun Oil Company's central production division, with headquarters in Evansville, Indiana. He is a veteran of more than a quarter century's service with Sun Oil, having joined the company in March of 1925.

Perkins was born at Calvert, Texas. He graduated from Beaumont, Texas, High School and was a four-letter man. He is a graduate of East Texas College of Law.

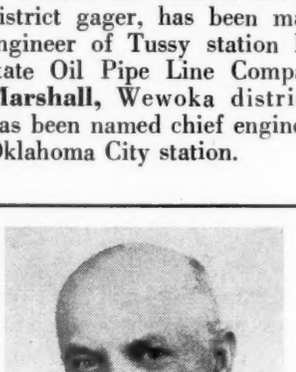
After joining Sun Oil in the production department (Texas), he was transferred in 1931 to Sun Pipe Line Company (Texas) and kept the latter's books until July, 1938, when he went to Evansville as office manager.

At Evansville, Perkins was a member of the Evansville Petroleum Club, and a member and director of the Evansville chapter of the National Office Management Association.

Walter R. Richardson, Wilson district gager, has been made chief engineer of Tussy station by Interstate Oil Pipe Line Company. **Joe Marshall,** Wewoka district gager, has been named chief engineer of the Oklahoma City station.



John F. Merriam



Burt R. Bay

John Merriam has been elected by the board of directors of Northern Natural Gas Company to succeed **Burt R. Bay** as president. Bay's retirement is consistent with the company's policy of retirement at the age of 65. He continues as a director of both Northern Natural and Peoples Natural Gas.

Merriam has worked for Northern Natural since the first year of its existence in 1930. He has been assistant secretary, assistant to the president, secretary-treasurer, vice president, and treasurer. He has been a director of the company since 1946.

Bay entered the natural gas industry in his youth as a machinist with the Columbus Natural Gas Company. He became executive vice president and a director of Northern Natural in 1938, having previously been president of Panhandle Eastern Pipe Line Company. He was made president of Northern Natural January 1, 1939.

▸ **O. Q. Lomax** has been elected president of Humble Pipe Line Company upon the retirement of **R. V. Hanahan,** former president. **A. E. Pecore** was appointed vice president, succeeding Lomax. Hanrahan took his first job in a field connection gang for the Indiana Pipe Line Company and thereafter served in many varied pipe line jobs until 1919, when he joined Humble Pipe Line Company soon after its organization. He was elected to the company's board of directors in 1920, vice president and general manager the same year, and was elected president in 1925. He has served as president for 25 years.

Lomax began his career in 1917 as an engineer-draftsman with Empire Gas and Fuel Company in Oklahoma. In 1918 he joined Humble Oil and Refining Company and was engaged in making preliminary plans for the construction of the Baytown Refinery. He transferred to Humble Pipe Line Company early in 1919 and after brief jobs with other companies returned to Humble Pipe Line Company in 1924. He was elected to the company's board of directors and made vice president and general superintendent in 1942, and has served in such capacities since that time.

A. E. Pecore joined the Humble Pipe Line Company in 1919 and served in several engineering capacities until 1945, when he was named chief engineer. In 1949 he was made general superintendent of the company.

▸ **Fred H. Pennington** has been elected by the board of directors of Magnolia Pipe Line Company to be comptroller of that organization. He has been Magnolia tax accountant in the comptroller's department. His services began 27 years ago at the company's Beaumont refinery. **J. B. Morgan,** chief accountant of Magnolia Pipe Line Company, was named as assistant comptroller. Morgan, also an assistant treasurer, has been with Magnolia Pipe Line Company for more than 32 years.

▸ **S. B. Bean** has returned from Venezuela where he has been assisting with construction of the "Steep-Inch" products pipe line for the Shell Caribbean Petroleum Company. He has returned to his regular post as division superintendent, Wasson-Hobbs, Shell Pipe Line Corporation. **P. M. Crenshaw,** who has been acting for Bean during his absence, returns to his position as district foreman, Benedum. Other changes also have been occasioned by Venezuelan transfers. **W. H. Craddock** has become superintendent, Bayou Pipe Line System, with headquarters in Port Neches. **C. E. Slater** is acting division superintendent, Kilgore, and **W. R. Yates, Jr.,** acting district foreman, Kilgore.

▸ **Frank Tuttle** has resigned as superintendent of Cities Service Gas Company's Straight compressor station to accept a position with the Michigan-Wisconsin Pipe Line Company. **George Arterburn** has been transferred from Matfield Green station to become superintendent at Straight. **Dave Frederick** of the Wichita station becomes superintendent at Matfield Green, and **C. S. Smith** of the Caney station superintendent at Wichita.

▸ **George B. Randels,** general superintendent of the Northern division of Interstate Oil Pipe Line Company, has been loaned to Interprovincial Pipe Line Company, Ltd., to assist in getting this new line in operation. Randels has had more than 30 years' service with Interstate and its predecessor, Oklahoma Pipe Line Company.

▸ **D. R. Harris** has been promoted to superintendent of the Abilene, Texas, compressor station by Lone Star Gas Company. He has been with the company since 1923 and recently has been superintendent of the Ibex plant.

PIPE LINE PROJECTS

2132-Mile Gas Line Planned For Canada

The Canadian Delhi Oil Company, Ltd., subsidiary of Delhi Oil Corporation, of Dallas, Texas, has filed application with the Alberta Petroleum and Natural Gas Conservation Board to export natural gas from Alberta to the eastern provinces of Saskatchewan, Manitoba, Ontario, and Quebec.

The company said it is considering the construction of a 2132-mile pipe line at an estimated cost of $220,000,000, extending from the Princess area of Alberta to Montreal. Proposed route of the line has already been surveyed by the Oklahoma City Corporation, Dallas.

The line would have a capacity of 365,000,000 cu ft of gas daily at 85 per cent load factor. It would be 30-in. in size.

The company is planning to make application to Canadian House of Commons at its next session for a charter for the pipe line, possibly under the name of Trans-Canada Pipe Line Company.

The application stresses that the proposed line would contribute to the growth and development of Canada and make the country less dependent on outside sources of fuel.

It is the fifth major application to the board for permission to export gas out of Alberta. The Alberta government has a natural gas policy that the gas will first serve Alberta, with any excess for use by other Canadian markets or export.

Michigan-Wisconsin Expansion Order Upheld

The Federal Power Commission has denied the joint petitions filed by the State of Wisconsin and the Public Service Commission of Wisconsin for rehearing of two opinions and orders issued by the FPC July 14 in proceedings involving Michigan-Wisconsin Pipe Line Company and Michigan Consolidated Gas Company, both of Detroit, Michigan, and subsidiaries of American Natural Gas Company.

One of the July 14 orders authorized the construction of facilities designed to nearly double the annual sales capacity of Michigan-Wisconsin's Texas-to-Michigan natural gas pipe line system. The concurrent opinion and order authorized Michigan-Wisconsin to lease from Michigan Consolidated and operate existing and proposed storage facilities in the Austin and Goodwell fields in Michigan.

The State of Wisconsin and the Wisconsin Public Service Commission contended that the FPC erred in not making a finding as to the relative benefits that Michigan-Consolidated and the markets west of Michigan will receive from the operation of the storage fields. The petitions also alleged that the FPC failed to make any finding or give consideration, in connection with Michigan-Wisconsin's rate computations, to the fact that there may be a tax saving if a consolidated income tax return is filed on behalf of Michigan-Wisconsin and other subsidiaries of American Natural Gas Company.

The commission found in both cases that the assignments of error and grounds for rehearing set out by the petitioners "do not raise any questions of fact or of law not fully considered by the Commission prior to the issuance of its opinion and order herein; and do not warrant further hearing, modification or revocation of said opinion or order."

MidSouth Gas To Acquire Pipe Line Facilities

The Federal Power Comission has authorized MidSouth Gas Company, of Little Rock, Arkansas, to acquire from Arkansas Power and Light Company, also of Little Rock, such of its existing pipe line facilities in Arkansas as are used or to be used for the transportation of natural gas in interstate commerce subject to the jurisdiction of the FPC. The facilities to be acquired, consisting of about 26 miles of main line and distribution systems serving communities in eastern Arkansas, are situated in the counties of Lawrence, Craighead, Independence, Jackson, White, Ashley, Chicot, and Desha. Contemplated purchase price for the properties will be their depreciated book cost of $1,942,817.94.

Texas Illinois Asks For Increased Capacity

Texas Illinois Natural Gas Pipeline Company, of Chicago, Illinois, has applied to the Federal Power Commission for authorization to construct facilities that would increase the authorized capacity of its recently approved pipe line system from 305,000,000 cu ft a day to a new total of 374,000,000 cu ft.

The FPC last June authorized the company to build at a cost of approximately $117,000,000 a pipe line project extending from Texas to Illinois and having an overall length of 1331.5 miles. The system, construction of which has begun, will carry natural gas ultimately destined for market areas in Illinois and Indiana.

To accomplish the newly proposed increase in capacity of the line, Texas Illinois plans certain changes in the units powering its compressor stations and proposes to build approximately 72 miles of new line in Texas in order to deliver the additional gas to the main pipe line system.

Estimated total capital cost of the proposed new construction program is $11,581,800.

The additional gas would be sold in part to some of Texas Illinois' presently authorized customers, with the remainder to be made available to communities along the route of the company's pipe line system not yet receiving natural gas.

New York Pipe Line Granted FPC Authority

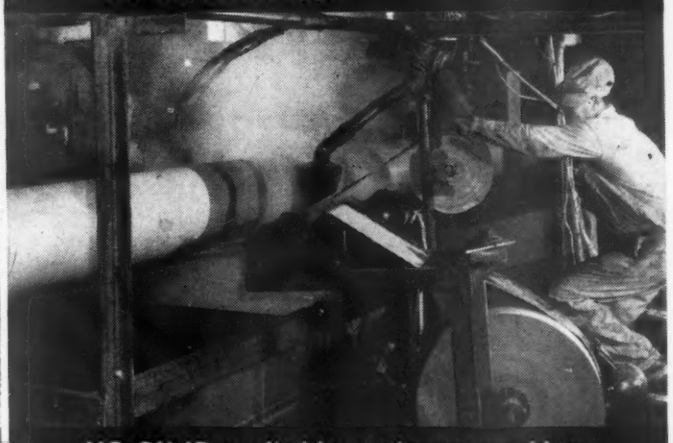
The Federal Power Commission has granted temporary authorization to New York State Natural Gas Corporation, of New York City, to construct approximately 44½ miles of pipe line to connect the Leidy gas field with the company's natural gas transmission system in Pennsylvania.

The new line, to be of 16 and 18-in. diam pipe, is estimated to cost $1,582,708, and will enable the company to take at least 60,000,000 cu ft of natural gas per day from the Leidy field. New York State Natural has been transporting gas from the field through a 6-in. oil line, which it leased temporarily.

NO-OX-ID cold applied by hand

NO-OX-ID hot applied with granny rag

NO-OX-ID applied by traveliner



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On your next pipe line job, find out how you can get economical, long term protection with the correct combinations of NO-OX-IDs and NO-OX-IDized wrappers. Your Dearborn engineer is ready to assist you in the selection of the correct NO-OX-ID and the best methods of application for your particular pipe line job.

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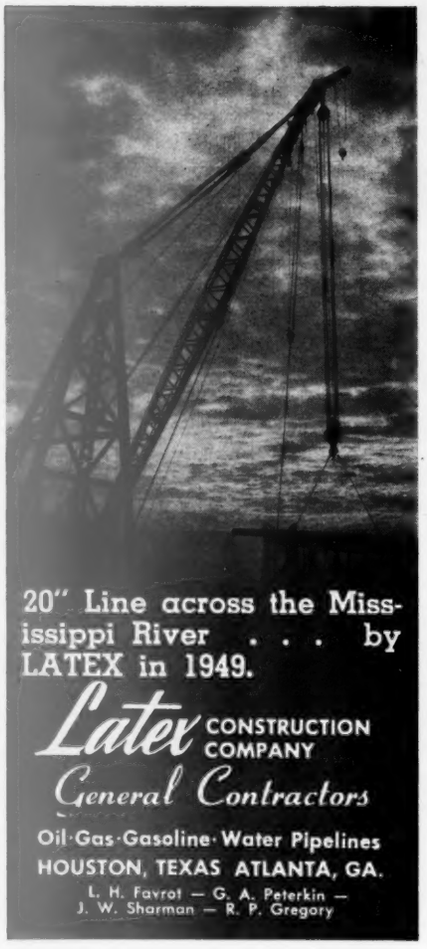
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HOUSTON, TEXAS ATLANTA, GA.
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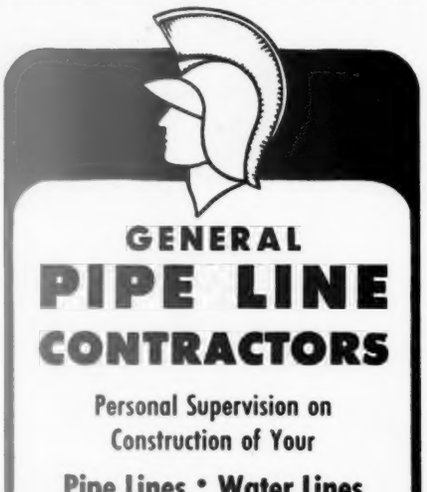


Products Line From Gulf Coast to Middlewest

Plans for a new petroleum products pipe line to carry gasoline, distillates, and liquefied petroleum gases have been announced by the United States Pipe Line Company, a Delaware corporation.

United States Pipe Line Company will construct, own, and operate its product pipe line system from the Texas Gulf Coast to concentrated inland markets of the Middlewest. This system will transport various petroleum products from the Houston-Beaumont area to the general service areas of St. Louis and Chicago, with terminal facilities en route in adequate marketing territories, and with extensions east from St. Louis to connect with new and existing product pipe lines.

This line will be a "common carrier," independently-owned and operated, with no shipper-owner affiliations, with no investments by oil company shippers, and with contracted reservations for space.

Adequate finances, satisfactory steel supplies, and experienced management by nationally recognized executives in the products pipe line industry have all been arranged for, it is stated. Early construction is planned, with particular consideration for the accelerated urgency and broad flexibility demanded of this system as an essential element of the integrated overall National Defense Program.

E. Holley Poe and Paul Ryan, with offices at 70 Pine Street, New York City, are the principal officers responsible for the present development of the United States Pipe Line Company. Arrangements have already been concluded to add in the immediate future other management, executives, and operating personnel, the announcement says.

Basin System to Add Booster Stations

Capacity of the Basin Pipe Line System will be increased with the installation of four additional booster stations and additional tankage at the Colorado City, Texas, station and the modification of existing stations, it was announced by R. B. McLaughlin, president of The Texas Pipe Line Company, which operates the system.

Plans have been finalized and equipment ordered to increase the capacity of the system, which extends from Jal, New Mexico, to Cushing, Oklahoma. It is owned on an undivided interest basis by The Texas Pipe Line Company, Shell Pipe Line Corporation, Sinclair Refining Company, and Cities Service Pipe Line Company. Completed in July, 1949, the system now is operating at maximum capacity.

The capacity of the segment of the system from Colorado City to Wichita Falls will be increased from 250,000 to 350,000 bbl a day and between Wichita Falls and Cushing from 270,000 to 385,000 bbl a day.

Every effort will be made to complete the construction work on the system so that the additional capacity will be available in the spring of 1951.

The need for the increased capacity is attributable to the substantial development of new "reef" oil fields in Scurry, Borden, Dawson, and Kent Counties, Texas. A total of 115,000 bbl a day from these counties alone will be received into the Colorado City station of the Basin System during the current month.

United Gas Granted Temporary Authorization

United Gas Pipe Line Company, of Shreveport, Louisiana, has received temporary authorization from the Federal Power Commission to construct approximately 16 miles of pipe line, a compressor station, and a dehydration plant in Webster, Bossier, and Ouchita parishes, Louisiana.

The new facilities, estimated to cost approximately $1,813,000, will have a daily capacity of about 100,000,000 cu ft of natural gas.

Equitable Gas Plans Pipe Line Facilities

Equitable Gas Company, of Pittsburgh, Pennsylvania, has received temporary authorization from the Federal Power Commission to construct natural gas facilities near Waynesburg, Pennsylvania, which would increase the capacity of the company's pipe line system by approximately 21,000,000 cu ft per day. The project, estimated to cost $1,684,700, includes a new compressor station, dehydration plant, and a total of 32,200 ft of 16-in., 4700 ft of 12-in., 42,000 ft of 6-in. and 11,000 ft of 8-in. pipe line.

Four 880-hp units will be installed in the compressor station, 3 to be used in the winter to relay gas to the company's system, thereby increasing the capacity by 21,000,000 cu ft daily. During the summer the units will be used to compress gas received from Texas Eastern Transmission Corporation for storage in Equitable's proposed Pratt and existing Jefferson storage pools. The fourth compressor unit will be used initially to pump about 4,000,000 cu ft of natural gas per day from local fields into the company's system.

Trinidad, Colorado, Seeks Natural Gas Supply

The City of Trinidad, Colorado, has requested the Federal Power Commission to order Colorado Interstate Gas Company, of Colorado Springs, Colorado, to connect its pipe line facilities with those proposed to be built by the city and to sell 1,000,000 cu ft of natural gas a day for distribution in Trinidad.

The city plans to construct a 35-mile, 8⅝ in. line extending from Colorado Interstate's facilities to a distribution system to be built in Trinidad. Estimated total capital cost of the proposed project is $1,100,000.

Five New Stations For Ozark System

Plans to construct five new pump stations along the Ozark Pipe Line System are announced by Shell Pipe Line Corporation, operator of the line, which is owned by Shell and The Texas Pipe Line Company. The new stations and modifications of existing stations will increase the capacity of the system approximately 68,000 bbl a day. T. E. Swigart, president of Shell Pipe Line, said it is hoped the stations will be in operation by the spring of 1951.

Together with the Basin Pipe Line System, the Ozark System provides a 1000-mile artery linking oil-fields in West Texas and New Mexico to mid-west refineries. The Basin System runs from Jal, New Mexico, to Cushing, Oklahoma, and the Ozark from Cushing to Wood River, Illinois, where it is joined by an extension to Patoka, Illinois, wholly owned by Texas Pipe Line. Completed in the summer of 1949, the lines are already delivering more crude oil than they were designed to carry, but are still unable to handle growing transportation demands.

Behind the need for increased capacities in the system is the development of new "reef" oil fields in Scurry, Borden, and Kent counties, Texas, and the enlargement of mid-western refineries. A total of 115,000 bbl a day from the new "reef" fields alone is scheduled to be pumped into the Basin System this month at its Colorado City station, and much of this oil is for delivery via the Ozark System and its Patoka extension.

The five new Ozark stations will be situated near Wildhorse and Fairland, Oklahoma, and Lawrenceburg, Swedeborg, and Labadie, Missouri. Plans call also for modification of the pumps in the five stations completed last year.

The Ozark System at present has a year-round average daily capacity of about 207,000 bbl. When the announced project is completed, it will be able to carry an average 275,000 bbl a day. A similar increase in capacity will also be provided for the Patoka extension by modifying equipment at the present Wood River station and constructing a booster station beyond.

Besides its 55-per cent share of the capacity of the 22-in. diam Ozark line. Shell Pipe Line continues to operate a 10-in. diam line from Cushing to Wood River. This line was built in 1928, and was equipped with new electric pumping units last year.

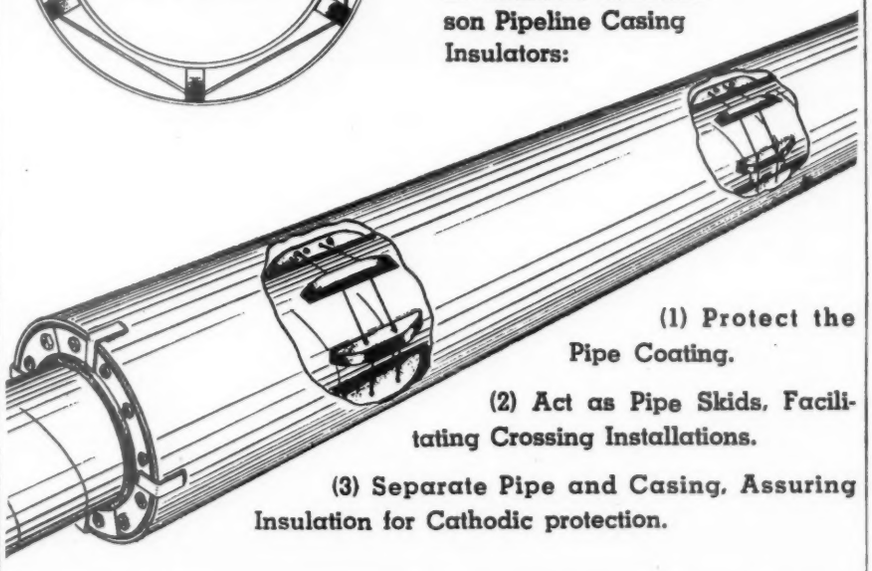
Michigan Gas Storage To Install Compressors

The Federal Power Commission has granted temporary authorization to Michigan Gas Storage Company, of Jackson, Michigan, to install two 2200-hp compressor units at an existing compressor station on its natural gas transmission system in Michigan.

The additional units are designed to enable Michigan Gas to pump from its storage fields additional volumes of gas required to supply Consumers Power Company, also of Jackson, on peak days during the coming winter.

WILLIAMSON "CONCENTRIC SUPPORT"
PIPE LINE CASING INSULATOR*

This improved Williamson Pipeline Casing Insulator approximately centers the line pipe in the casing. This removes support of pipe from "WmSEAL" Casing Bushings, and facilitates their installation. In addition, Williamson Pipeline Casing Insulators:



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More Data On Expansion Asked of Texas Eastern

The Federal Power Commission has granted a motion made by its staff counsel to require Texas Eastern Transmission Corporation, of Shreveport, Louisiana, to submit additional evidence in the proceeding involving the company's proposal to expand the daily sales capacity of its pipe line system by 476,000,000 cu ft of natural gas a day.

The order requires Texas Eastern to submit an estimated system-wide cost of service, including 6 per cent return, on a net investment rate base with operating expenses itemized in the detail required on a schedule of the FPC's Annual Report Form No. 2 for the years 1952 through 1957. Texas Eastern is required to submit the data before or on the day the hearing on its application reconvenes. The hearing was recessed September 13 to reconvene at a date to be set by the commission.

The commission staff had requested the information during the course of the hearing, and later repeated the request in a letter to Texas Eastern. Texas Eastern subsequently indicated that it would not voluntarily comply with the request.

Proposed Rate Increase Becomes Effective

The Federal Power Commission has issued an order making effective a proposed increase in rates for wholesale natural gas service by Northern Natural Gas Company, of Omaha, Nebraska, provided the company supplies within 15 days a $250,000 bond satisfactory to the FPC. The order requires Northern Natural to keep accurate accounts of all amounts received by reason of the increased rates, and provides that if upon conclusion of the proceeding the Commission finds any portion of the increase not to be justified, Northern shall refund the money to those customer companies entitled to it, together with interest at the rate of 6 per cent per year from the date of payment.

Northern's suspended schedules would increase rates for natural gas sold to 28 distributing companies that distribute gas in about 230 communities in Kansas, Nebraska, Iowa, Minnesota, and South Dakota. Among the cities obtaining gas from Northern's system are Minneapolis, St. Paul, and Rochester in Minnesota; Des Moines, Fort Dodge, Sioux City, and Mason City in Iowa, Lincoln, Nebraska, and Sioux Falls, South Dakota.

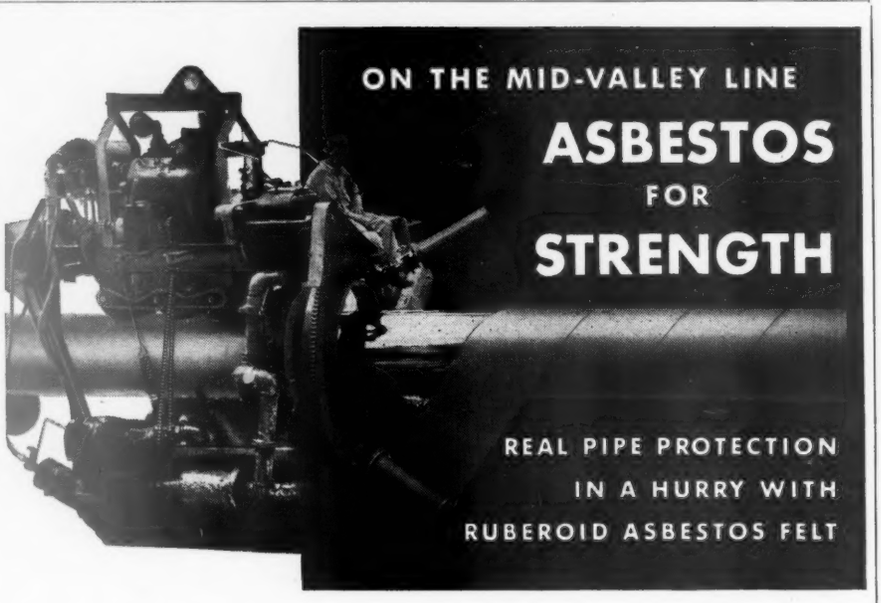
Gas Line Facilities Authorized by FPC

The Federal Power Commission has authorized Bluefield Gas Company, of Bluefield, West Virginia, and Amere Gas Utilities Company, of Charleston, West Virginia, to construct facilities designed to carry natural gas for distribution in Bluefield, West Virginia, and Bluefield, Virginia.

Amere, a subsidiary of Atlantic Seaboard Corporation, a member of the Columbia Gas System, Inc., will sell gas to Bluefield Gas Company, which will transport the gas to its distribution system at Bluefield, West Virginia, and the distribution system of its subsidiary, Commonwealth Public Service Corporation, at Bluefield, Virginia.

Estimated annual requirements of Bluefield Gas Company and its subsidiary are 110,600,000 cu ft the first year and 235,000,000 cu ft the fifth year. The estimated peak day demand is 500,000 cu ft the first year and 1,725,000 cu ft in the fifth year.

To make deliveries to Bluefield Gas Company, Amere will build a measuring and regulating station at an estimated cost of $9000. Bluefield will construct approximately 14.3 miles of 6-in. line to transport the gas to its distribution system. Total cost of the Bluefield project is $267,200.



The Mid-Valley Pipeline Company of Longview, Texas, is now completing a 1000-mile crude oil line from Longview to Lima, Ohio. A third of the entire line will be covered with Ruberoid Imperial Asbestos Felt, giving a more economical and lasting protection. For pipe engineers have found that under most soil conditions a saturated asbestos felt and enamel coating provide a pipe line with the best defense against both physical and corrosion hazards.

The long-fibred strength (asbestos — not wood pulp) of Ruberoid pipe covering is added insurance against jagged rocks, electrolysis, soil distortion and settlement. Long range economy in pipe maintenance is assured by the enduring performance of Ruberoid Imperial Asbestos Felt.

—And in a Protected Package!
This is another exclusive Ruberoid development. The weather hazards of field-wrapping jobs are greatly reduced by this new package which is constructed of water-proofed kraft and special edging seal.

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With the PIPE LINE CONTRACTORS

R. H. Fulton and Company, Box 1526, Lubbock, Texas, is engaged in construction of the following projects:

For Northern Natural Gas Company, 155 miles of 20-in. between Jetmore and Bushton, Kansas. Jerry Nash is superintendent.

From Concordia to Salina, Kansas, 73 miles of 26-in. for Northern Natural. M. L. Boyd is superintendent.

For Trunkline Gas Supply Company, 184 miles of 26-in. from Senatobia, Mississippi, to Joppa, Illinois. Ed Veach is superintendent and Bill Gray manager of the field office.

Clark Williams is general superintendent over all the above work.

Between McAllen and Altair, Texas, 264 miles of 20-in. for Trunkline Gas Supply Company. This is a joint venture between Fulton and J. T. Brodie. The field office is at El Campo with J. T. Brodie the superintendent.

Midwestern Constructors, Inc., 105 North Boulder Street, Tulsa, Oklahoma, expected to complete by November 1 the 120-mile gathering line being engineered near Hooker, Oklahoma, for Plains Natural Gas Company. The field office is at Liberal, Kansas, and T. S. Nunley is chief inspector.

Scheduled for completion November 15 are two Northern Natural Gas Company jobs: 43.4 miles of 26-in. between Palmyra, Nebraska, and Oakland, Iowa, and 65.9 miles of 26-in. northeast from Oakland. The field office is at Oakland, with M. T. Wilhite superintendent and Denver Franklin assistant superintendent. Additions are being made to two compressor stations for Northern Natural. The one at Palymra is in charge of Lyle S. DeWitt and the one at Beatrice, Nebraska, is being supervised by J. A. Bard.

Pipe laying is expected to begin November 1 on Schedule 1 of Texas Illinois Natural Gas Pipeline Company, consisting of 100 miles of 26-in. from LaGloria to Refugio, Texas. The field office is at Kingsville. M. T. Wilhite will be in charge and Denver Franklin will be his assistant.

Schedule 11, approximately 100 miles of 30-in. from the Mississippi River near Chester, Illinois, to Effingham, Illinois, got underway September 23. The field office is at Murphysboro. John Work is superintendent and Mac Hoffman assistant superintendent.

Schedule 12, consisting of 100 miles of 30-in. from Effingham to Sibley, Illinois, is scheduled for 1951, as is Schedule 13, 92 miles of 30-in., from Sibley to Joliet.

The contractor also will lay a crossing of the Illinois River near Morris, Illinois.

Station additions at the Sioux City, Iowa terminal station of Great Lakes Pipe Line Company are expected to be completed December 1. F. C. Snavely is the superintendent. Additions at the Mankato, Minnesota, station were completed in October. Earl S. Powell was in charge.

Oklahoma Contracting Corporation, 1210 Mercantile Bank Building, Dallas, Texas, has finished laying the line for Portland Pipe Line Company between Portland Maine, and Gorham, New Hampshire, 85 miles of 18-in.

The Transcontinental line between Edgewater and Elizabeth, New Jersey, also has been completed; however, work has begun on a 17-mile lateral to Paterson consisting of 8.5 miles of 30-in. and 8.5 miles of 10-in.

The work in Mississippi for Tennessee Gas Transmission Company has been completed except for two stream crossings (October 19).

On the Transcontinental job in South Texas, 11 miles remained to be laid. The field office is at Edna with "Panama" Shiflett superintendent and Earnest Smith paymaster.

A small job is being done for Texas Eastern Transmission Corporation near Little Rock, Arkansas. Five miles of 24-in. are being laid and a temporary line installed across the Arkansas River. Ed Flanagan is in charge. The field office is in North Little Rock.

Texas-Southern Contracting Company, 804 Dan Waggoner Building, Fort Worth, Texas, had about 10 days' clean-up work remaining on the Transcontinental job as of October 19. This consisted of 92 miles of 30-in. from Deweyville to Porters, Texas. The field office is in Beaumont with "Red" Tatom superintendent and Lee Price office manager. The Trinity and Sabine River crossings were being completed. "Borger Red" McMenamy was in charge of this work.

The United Gas Pipe Line Company job has about another month to go. From Cameron Parish, Louisiana, to Gulf's refinery at Port Arthur, 24 miles of 16-in. are being laid. Work is now in the refinery proper and is slow. F. O. 'Banty" Traweek is superintendent and Q. B. Davis, Jr., office manager. The office is in Port Arthur.

H. C. Price Company, Bartlesville, Oklahoma, is working on a general contract covering construction of 373 miles of 26-in. high pressure natural gas pipe line for Tennessee Gas Transmission Company.

Work on the initial section of nearly 220 miles through Ohio is completed; work on 153-mile section through Pennsylvania and New York is 60 per cent finished as of October 10 and scheduled for completion this month. Spreads situated as follows:

Corry, Pennsylvania, G. A. Reutzel, superintendent; W. E. Yount, office manager, and the following foremen: J. A. Hairston, R-O-W; L. J. Loncarich, ditch; J. C. Anderson, bending; H. C. Morrison, pipe; K. N. Adkins, pipe; R. W. Orr, welding; S. J. Wood, coating; A. L. Bell, lower in; T. E. Walker, clean up.

Dunkirk, New York, R. K. Shivel, superintendent; R. E. Burgess, office manager, and the following foremen: J. D. White, R-O-W; W. H. Olrich, ditch; J. H. Latham, bending; C. E. Shivel, pipe; R. L. Ezell, welding; U. M. Beaver, coating; Sam Price, clean up; Ray Drewell, crossing; and G. E. Beaver, lower in.

General contract covering construction of approximately 480 miles of main transmission line for Texas Illinois Natural Gas Pipeline Company from near Refugio, Texas, and extending northeastward to the Texas-Arkansas state line near Texarkana. Contract includes 38 miles of 12-in.; 36 miles of 24-in.; 97 miles of 26-in., and 309 miles of 30-in. Right-of-way work now underway on 24-in. section out of Wharton and on 30-in. out of Cleveland, Texas. Work on multiple crossing of Trinity River scheduled to begin shortly. As of October 10, 1950, 18 miles of 24-in. and 16 miles of 30-in. had been laid. Spreads as follows:

Wharton, Texas, W. B. Williams, superintendent; P. O. Rutledge, office manager, and the following foremen: R. H. Edwards and D. L. Beachy, R-O-W; K. K. Kelly, ditch; Roy Stegall, bending; J. I. Cobb, pipe; C. F. Jones, welding; Rube Owens, coating; A. D. Hamilton, lower in; and Fred Williams, clean up.

Cleveland, Texas, C. R. Ice, superintendent; G. A. Harvey, office manager, and the following foremen: John E. Hamilton and Jesse Cash, R-O-W; E. W. Whisenant, ditch; Forest Loinette, bending; W. T. Dickerson, pipe; L. O. Reutzel, welding; N. D. Adams, coating; J. C. Rich, lower in; E. D. Worley, clean up.

Parkhill Truck Company, (stringing contractor), P. O. Box 1856, Tulsa, Oklahoma, has the following work under way:

One hundred and twelve miles of 26-in. for Mary Construction Company on Northern Natural Gas Company work from Holmes, Iowa, to Farmington, Minnesota. Charles Sampson is foreman.

One hundred and nine miles of 26-in. for Midwestern Constructors on Northern Natural Gas Company line from Plattsmouth, Nebraska, to Ogden, Iowa. Curtis Williams is foreman.

One hundred and eighty miles of 26-in. for Anderson Brothers Corporation on Trunkline Gas Supply Company job from Darnell, Louisiana, to Senatobia, Mississippi. R. C. Parker is foreman.

Two hundred and seventeen miles of 24-in. for Anderson Brothers on Trunkline Gas Supply Company job from Longville, Louisiana, to Garwood, Texas.

Thirty-three miles of 10-in., 18 miles of 16-in., 8 miles of 10-in. on Trunkline Gas Supply Company job for Houston Contracting Company between Longville, and southwest Louisiana.

One hundred and seventy-six miles of 26-in. line for Houston Contracting Company on Trunkline Gas Supply Company between Longville, Louisiana, and Darnell Louisiana. R. M. Hiser is foreman.

One hundred miles of 26-in. for Midwestern Construction on Texas Illinois line from LaGloria to Refugio, Texas.

Four hundred and seventeen miles 30-in. for Section 7, 8, 9, and 10, for the Texas Illinois Pipe Line Company system for W. A. Bechtel Company from Texarkana, Arkansas, to the Mississippi River near Cape Girardeau, Missouri. Gordon Walden is foreman.

For Midwestern Constructors, Inc., 300 miles of 30-in. for sections 11, 12, and 13, from the Mississippi River near Cape Girardeau, Missouri, to Joliet, Illinois, on the same line.

Houston Contracting Company, 3272 Westheimer Road, Houston, Texas, is laying for Trunkline Gas Supply Company 176 miles of 26-in. pipe between Longville, Louisiana, and Darnell, Louisiana; 41 miles of 10-in. and 18 miles of 6-in. laterals from Longville to the southwest Louisiana area. A field office has been opened at Rayville. Earl Norris is superintendent, R. E. Thornton spread foreman, and R. J. Axsom and Fred Brooks are in the office.

Bechtel Corporation, 220 Bush Street, San Francisco, California, began work in October on 54 miles of 20-in. crude oil line for Ohio Oil Company. The line is being laid in Illinois. A field office has been opened at 1360 St. Louis Boulevard, Vandalia, Illinois. S. D. Bechtel, Jr., is superintendent and W. H. Molander office manager.

Work has begun for the Texas Illinois Natural Gas Pipeline Company, which consists of 409 miles of 30-in. in Arkansas and Missouri. The field office is at the Airport in Newport, Arkansas. E. W. Davis is project manager, A. M. Berlander general superintendent, and E. C. Elting, office manager.

J. L. Cox and Son, Raytown, Missouri (stringing contractors), are stringing 232 miles of 16, 18, and 24-in. pipe in Mississippi and Alabama for Southern Natural Gas Company. The work was about 50 per cent completed October 16.

Between Dallas and Corsicana, Texas, a total of 177 miles of 8-in. line is being taken up for The Texas Pipe Line Company. The job was 25 per cent completed.

Near Streator, Illinois, work has just begun on taking up 12 miles of 8-in. for Sinclair.

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Model 125 — Delivers 125 cfm of air instead of 105, yet is as compact and portable as smaller units. Ideal for testing lines at pressures up to 125 psi.

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Model 365, instead of 315, and Model 600, instead of "old standard" 500 ft., give comparable increases in production. All units are simple, rugged, portable over any ground where trucks can travel. Tractor-mounted models are available for roughest terrain.

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Extremely compact, easy-to-handle and fast automatic priming centrifugals of ample capacity for dewatering ditches. 2" size conservatively rated at 10,000 gph.

Jaeger Compressors and Pumps are sold and serviced in 130 cities. See your Jaeger distributor or send for complete catalogs.

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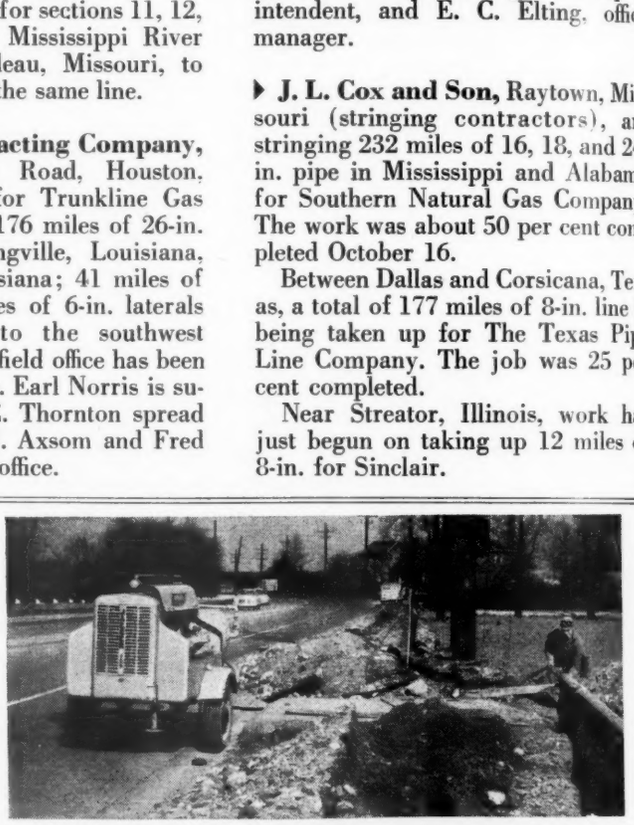
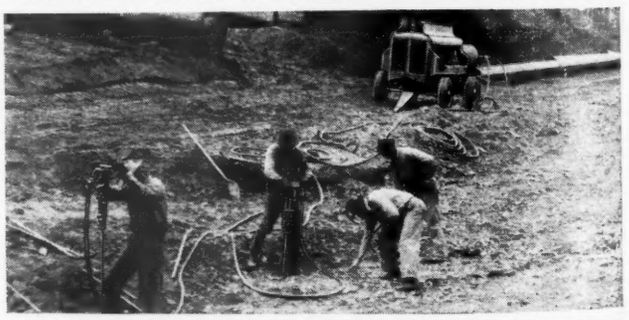




▸ **Latex Construction Company,** 2707 Ferndale Place, Houston, Texas, has the following construction work under contract:

Ninety-five miles of 20-in. gas line for Tennessee Gas Transmission Company from Natchitoches to Kinder, Louisiana. One spread is at Glenmora, Louisiana. F. A. Silar is superintendent; C. V. Oliver and L. F. Redfearn, office. Second spread, which was located at Oberlin, has completed the south 25 miles of this job and moved to Elton, Louisiana, to start on 16-in. J. A. Cantrell, superintendent; A. E. Stremmel, office manager.

One hundred and two miles of 16-in. gas line for Tennessee Gas Transmission Company from Bayou Sale to Kinder, Louisiana. One spread at New Iberia, Louisiana, completed the 12-in. and then moved over and completed the 46 miles of 16-in. at the Vermillion River by October 10. H. L. Leake, superintendent; S. B. Harrison, office manager. A second spread started at the Vermillion River October 10, with headquarters at Crowley, Louisiana. W. H. Hayes, superintendent; J. C. Strickler and J. B. Stoddard, office. The third spread on this job is J. A. Cantrell's, at Elton, Louisiana, which began laying at Kinder October 1.

Fifteen miles of 12-in. gas line for Tennessee Gas Transmission Company from a point north of Delcambre, Louisiana, south to vicinity of Tigre Lagoon. H. L. Leake, superintendent; S. B. Harrison, office manager; headquarters, New Iberia, Louisiana. Work began October 10.

Two 16-in. submarine lines across the Mississippi River just below the Greenville Bridge for Tennessee Gas Transmission Company. This job was started last winter but was not completed due to flood conditions. Work has been resumed. H. E. Murphy, superintendent; J. J. Nolan, office mgr.

▸ **Conyes Construction Corporation,** 2884 San Pablo Avenue, San Pablo, California, will lay 172 miles of 20 and 22-in. pipe for Ohio Oil Company between Vandalia, Illinois, and Carlos, Indiana. This is part of the 226-mile line being constructed by Ohio Oil from Wood River, Illinois, to Lima, Ohio.

▸ **Mahoney Contracting Company,** Hersee Building, Mt. Pleasant, Michigan, is laying 186 miles of 26-in. for Trunkline Gas Supply Company between Tuscola and Joppa, Illinois.

November 1, the contractor began laying 27 miles of 12-in. for Dow Chemical Company between Loomis and Midland, Michigan.

▸ **Williams-Austin Company,** Grant Building, Pittsburgh, Pennsylvania, is laying 25.5 miles of 10-in. line for the Acme Natural Gas Company between Ellwood and Butler, Pennsylvania. H. C. Bauer is superintendent and R. H. Condry timekeeper. The job is 75 per cent completed. (October 13.)

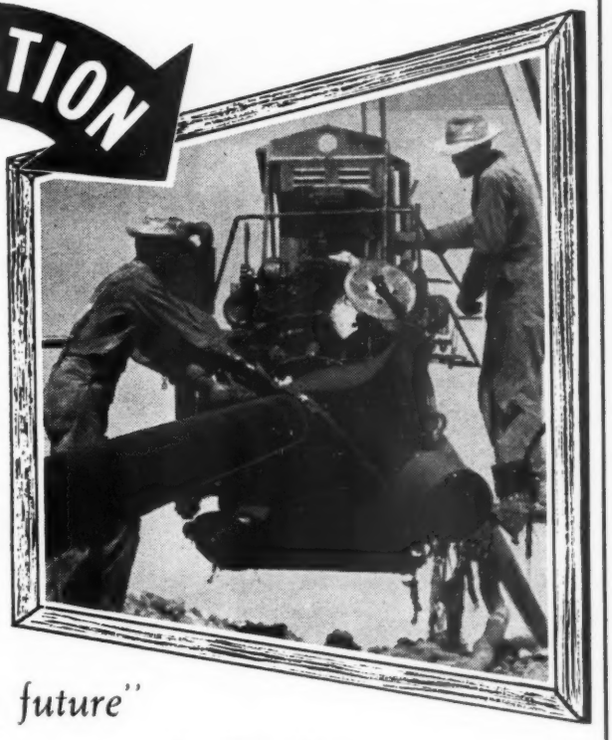
For New York State Natural Gas Company, 21 miles of 20-in. are being constructed from Bakerstown, Pennsylvania, to Tonkin station. This work was begun the middle of October. Ralph Gaddy is superintendent and E. E. Mayes timekeeper.

Between Foster, Kentucky, and the North Means compressor station, 42 miles of 20-in. are being laid for Central Kentucky Natural Gas Company. The job was 20 per cent completed the middle of October. Leman Creech is superintendent and L. A. Franks timekeeper.

All work will be completed by December 15. Ed Peters is general superintendent.

▸ **Arabian Bechtel Corporation,** 220 Bush Street, San Francisco, California, is laying 566 miles of 26, 30, and 32-in. pipe for Iraq Petroleum Company, Ltd., from Kirkuk to Baniyas. Clark Rankin, Bechtel vice president, is project manager.

PORTRAIT OF PROTECTION



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Burial tests, begun in 1930 by the Bureau of Standards and the API, showed the value of Asbestos Pipe Line Felt in protecting coatings of underground pipe.

Asbestos Pipe Line Felt protects the coating from distortion due to soil stress, minimizes backfill and lowering-in damage, and prevents abrasive wearing of the coating due to pipe movement.

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▸ **Dunn Bros.,** 801 Mercantile Securities Building, Dallas, Texas, have contracted to string 471 miles of pipe for H. C. Price Company on the Texas Illinois Natural Gas Pipeline Company project, as follows:

Section 2—100 miles of 26-in. from Refugio to Glenflora, Texas.

Section 3—36 miles of 24-in. from Old Ocean, Texas, to the main line, and 36 miles of 12-in. from Chocolate Bayou to the main line.

Section 4—109 miles of 30-in. from Glenflora to Urbana, Texas.

Section 5—91 miles of 30-in. from Urbana to Dotson, Texas.

Section 6—99 miles of 30-in. from Dotson to the Texas-Arkansas state line.

Other jobs being strung by the company are:

El Paso Natural Gas Company—415 miles of 24-in. between Fruitland, New Mexico, and Yucca, Arizona. (San Juan line.)

H. C. Price Company (Tennessee Gas Transmission Company)—400 miles of 26-in. in Ohio, Pennsylvania, and New York.

El Paso Natural Gas Company—419 miles of 30-in. in New Mexico, Texas, and Arizona.

▸ **Bechtel-Price-Conyes,** 220 Bush Street, San Francisco, California, will complete in November the Pacific Gas and Electric Company line between Topock, Arizona, and Milpitas, California, which is 506 miles of 34-in. R. L. Bowman is general superintendent of the project, M. V. Scott manager of the main line office at Coalinga, California, and Steve Valline administrative manager at San Francisco.

▸ **Reese Bros. Construction Company,** Hugoton, Kansas, had completed 61 miles (to October 15) of the 99-mile gathering system being constructed for Northern Natural Gas Company in the Hugoton, Kansas, area. Size of pipe is 4 through 10 in.

▸ **O. R. Burden Construction Corporation,** Box 5216, Tulsa, Oklahoma, is taking up and reconditioning 177 miles of 8-in. for Texas Pipe and Supply Company. The work is being done between Corsicana and Dallas with the field office in Waxahachie. About 75 miles had been taken up to October 12. Floyd Lewis is superintendent and J. S. Burden office manager. Work began October 11 on the laying of 12 miles of 8-in. between Ransom and Kernan, Illinois, for Sinclair Oil and Refining Company. The office is at Streator. O. P. Hiner is superintendent and Dick Draper office manager. Between Sweeny and Webster, Texas, 51 miles of 6- and 8-in. pipe are being laid and to October 10, 20 miles had been lowered-in. B. C. Hall is superintendent and Howard Smith office manager. The field office is at Alvin.

The company announces that Bill Eastman has replaced B. C. Bates, Jr., as general office manager in Tulsa.

▸ **Brown and Root, Inc.,** P. O. Box 3, Houston, Texas, has several jobs underway for United Gas Pipe Line Company. From the Shell Plant to Missouri City, 28.4 miles of 24-in. are being laid with Jimmie Riney the spread man. From Stringer to Meridian, Mississippi, 42 miles of 12¾-in. are being laid. Ray Austin is in charge. Between Lumberton, Mississippi, and Mobile, Alabama, 80 miles of 20-in. have been laid and a hydrostatic test is being made.

▸ **Anderson Brothers Construction Company,** 707 North Drennan Street, Houston, Texas, is working on a 180-mile section of 26-in. for Trunkline Gas Supply Corporation between Darnell, Louisiana, and Senatobia, Mississippi. The crossing of the Mississippi River near James, Mississippi, is also under way. Dewey Whitworth is in charge of the mainline work and Frank McCoy of the crossing. Construction of the 217 miles of 24-in. from Longville, Louisiana, to Altair, Texas, will not begin until the early part of 1951.

For Tennessee Gas Transmission Company, 45 miles of 30-in. are being laid between Lancaster and Campbellsville, Kentucky, and 75 miles of 26-in. between Morehead to Fullerton, Kentucky, and from Load to Catlettsburg, Kentucky.

▸ **Ray L. Smith and Son, Inc.,** El Dorado, Kansas, has two spreads at work on 104 miles of 18-in. for Commonwealth Natural Gas Corporation. The section is between Stanardsville and Richmond, Virginia. Don C. Smith is superintendent of the spread that has its headquarters at Orange, Virginia. Wm. G. "Bill" Frost is superintendent of the spread working out of the office at 5606 West Broad Street, Richmond, Virginia. Ray Leigh Smith is general superintendent over both spreads. Also contracted with Commonwealth are 84 miles of 12-in., 20 miles of 8-in., and various laterals between Richmond and Newport News.

▸ **Williams Brothers-Davis Company,** 6006 Jensen Drive, Houston, Texas, has under construction 85 miles of 30-in. for Transcontinental Gas Pipe Line Corporation. The pipe is being laid from El Campo to Humble, Texas. The field office is at the latter point. H. L. Davis is supervising the work. Sam Davis is timekeeper.

▸ **Price-Morrison,** Lockhart Building, 311 East Eleventh Street, Austin, Texas, as a joint venture, completed the middle of October the construction of 158 miles of 30-in. high pressure natural gas pipe line for Tennessee Gas Transmission Company in western Tennessee and Kentucky. Contractors: Price Constructors, Inc., Bartlesville, Oklahoma (sponsor), and Morrison Construction Company, Inc., Austin, Texas.

▸ **Smith Contracting Corporation,** 205 Northwest Seventh Street, Fort Worth, Texas, is now working two spreads on the Texas Eastern Transmission Corporation 16-in. line between Baytown and Provident, Texas. About 14 miles had been laid to October 19. Total mileage is 108. The field office is at Eagle Lake, both spreads working out of this point. J. H. Smith is superintendent and Ivan Steele office manager.

The Transcontinental job in the East has been finished. This consisted of 196 miles of 30-in. from Chatham, Virginia, to the Potomac River.

▸ **Brodie Construction Company,** Box 2064, Amarillo, Texas, is reconditioning 19 miles of 6-in. pipe and laying 19 miles of 10-in. for West Texas Gas Company between Anton, Texas, and the Lubbock Air Base. For the same company, 6 miles of 6-in. are being laid at Seminole, Texas. North of Amarillo, 10-in. and 12-in. crossings are being made across the Canadian River for the Amarillo Oil Company, a total of 10 miles being installed.

▸ **Sheehan Pipe Line Construction Company,** 529 National Bank of Tulsa Building, Tulsa, Oklahoma, began construction October 23 on 32 miles of 16-in. for Southern Natural Gas Company between Wetumpka and Tallassee, Alabama. For the same company 130 miles had been completed (October 12) of the 180 miles of 18-in. being laid from Gwinville, Mississippi, to Selma, Alabama.

▸ **Canadian Bechtel, Ltd.,** and **Fred Mannix and Company, Ltd.,** Calgary, Alberta, Canada, have completed the 441 miles, 20-in. crude oil line between Edmonton and Regina for Interprovincial Pipe Line Co.

▸ **H. L. Gentry Construction Company,** 921 Michigan Avenue, Jackson, Michigan, is laying 126 miles of 8⅝-in. OD pipe for Susquahanna Pipe Line Company between Toledo, Ohio, and Sarnia, Canada. The job has been divided into two spreads with Frank Morris general superintendent and James G. Mitchell spreadman.

NEWS

Sees Greater Steel Demand For Petroleum Industry

Seventeen and four-tenths per cent more steel will be needed in 1951 by the petroleum industry, Secretary of the Interior and Defense Petroleum Administrator Oscar L. Chapman has reported. Drawn up by the National Petroleum Council's committee on steel requirements, the report was based on Chapman's estimate that the nation's total requirements for petroleum, continuing the "normal growth" in its use, will increase to 7,200,000 to 7,300,000 bbl a day in 1952, about 200,000 bbl a day more than anticipated 1951 requirements and 500,000 bbl a day more than estimated current requirements.

The committee reported that the industry will require about 9,923,000 short tons of steel this year and 11,650,000 tons in 1951.

B of M Sees No Fuel Or Gasoline Shortage

No gasoline or fuel shortages are expected this winter in spite of increased demands, the Bureau of Mines announced in its monthly forecast of market demand for crude oil. "From present indications," the Bureau stated, "it is estimated that the continuation of refining operations during the winter, at about the rate for the third quarter, will supply all requirements." The Bureau added that primary stocks of refined products had declined to 319,400,000 bbl July 31, 1950—almost 40,000,000 bbl less than July 31, 1949, but added the stock situation had been materially improved as a result of higher crude runs in August and September.

The economics committee of the Independent Petroleum Association of America has predicted all-time record higher petroleum requirements of 7,008,000 bbl daily in the 12-month period ending September 1, 1951. The predicted total demand will increase 5.7 per cent in the next 12 months. It told the Association at its 21st annual convention that this will mark the first time domestic consumption will pass the 7,000,000 mark for a yearly demand.

Industrial Wastes Control

A course on "The Effect of Industrial Waste on Aquatic Life" was held by the Texas Engineering Extension Service in Houston recently. Open to all industries of the metropolitan area of Houston, the course dealt with Texas A & M's program on the pollution control of industrial wastes.

Some Producers Set Higher Prices for Crude Oil

Following the general trend of other commodity costs, the price of crude oil may be on the threshold of a general upsweep. Petroleum producers state that the cost of getting oil from the earth to the consumer, is pushing steadily upward, and "rising costs can only be offset by increased prices," L. F. McCollum, president of Continental Oil Company, warned.

All grades of Pennsylvania grade crude oil went up 10 cents a barrel recently. The Joseph Seep Purchasing Agency said the hike was designed to encourage producers to boost output.

In West Texas, three oil firms have announced price raises. Onyx Refining Company and Pan American Production Company have joined in the 7-cent upward adjustment in the price of crude oil. This restores a reduction of 7 cents a barrel, which it initiated on January 1 of this year. In Scurry County, West Texas, Magnolia Petroleum Company has posted 7-cent increase on oil of 40 gravity and above, with a 2-cent differential downward per degree of gravity to $2.33 a barrel for 25 gravity.

Various companies have posted product price hikes through the country. Richfield Oil Corporation, following Standard of California's lead, has increased prices in the San Francisco Bay areas. An immediate increase of 4/10ths of a cent a gallon for gasoline and other light oils was announced by Richfield. In addition it advanced prices 3/10ths of a cent a gallon in Portland and Seattle and 2/10ths of a cent elsewhere.

Gulf Oil Corporation raised its East Coast residual fuel oil prices in amounts ranging from 10 cents a barrel at Port Tampa, Florida to 15 cents at Boston, Massachusetts. Indiana Standard Oil Company has raised the price 0.5 cents a gallon for domestic heating oil in the metropolitan Chicago, Illinois area, and The Texas Company has gone up 2/10ths to 4/10ths of a cent a gallon for its gasoline and refined oil products sold by the company's Pacific Coast division.

Sets Natural Gas Reserves at 500 Trillion Cubic Feet

Lyon F. Terry, vice president of the Chase National Bank told members of the American Gas Association that future recoverable natural gas in the United States will probably exceed 500 trillion cubic feet. Speaking before AGA's annual convention, Terry said the proved reserves are now about 180 trillion cubic feet. Future discoveries may be expected to yield at least 280 trillion cubic feet from land and 50 trillion cubic feet from tidelands. Ratio of oil to gas should increase, he added, because of the greater depth of oil wells. Proportionately more gas in solution will be recovered from deep wells than from deposits in shallow reservoirs, Terry prophesied. In addition to this, he added that drillings in the Gulf Coast area have recently known an increased proportion of gas to oil wells discovered.

Canada's Gas Reserves Up

Canada's known natural gas reserves have increased 2.1 trillion cubic feet in the past year and-a-half, according to a government survey. The area's reserves, on June 30 stood at an estimated 7000 billion cubic feet in place at atmospheric pressure and temperature, and 6400 bilion cubic feet at 100 lb abandonment pressure.

Members of the survey team stressed the difficulties of appraising the area's gas resources "when little or no active exploration for natural gas" has been undertaken. They added that if large markets and attractive prices warranted a vigorous search for gas, further large quantities would be found in amounts far exceeding those "now proved and probable."

Frank Porter Honored

Friends and business associates paid tribute to Frank Porter, president of the American Petroleum Institute, recently in Oklahoma City, Oklahoma. Several hundred of them, headed by Tom Marshall, chairman of the Oil and Gas Division of the Oklahoma City Chamber of Commerce and his directors, were on hand to see him receive an inscribed scroll from Wm. T. "Bill" Payne, president of the Kansas-Oklahoma division of the Mid-Continent Oil and Gas Association and past chairman of the Chamber group.

Mexico Sets 1951 Oil Goal At 100,000,000 Bbl

Mexico has set its goal for oil output at 100,000,000 bbl in 1951, Antonio Bermudez, head of Pemex, the government's oil corporation, has reported. This is twice as much as previous estimates. Bermudez made his estimate after returning from the "El Plan" field in Vera Cruz state. He said the daily production would probably be 300,000 bbl before the end of 1950—109,000,000 bbl a year. In 1947 Pemex's production department estimated that the 1950 production would be 49,300,000 bbl.

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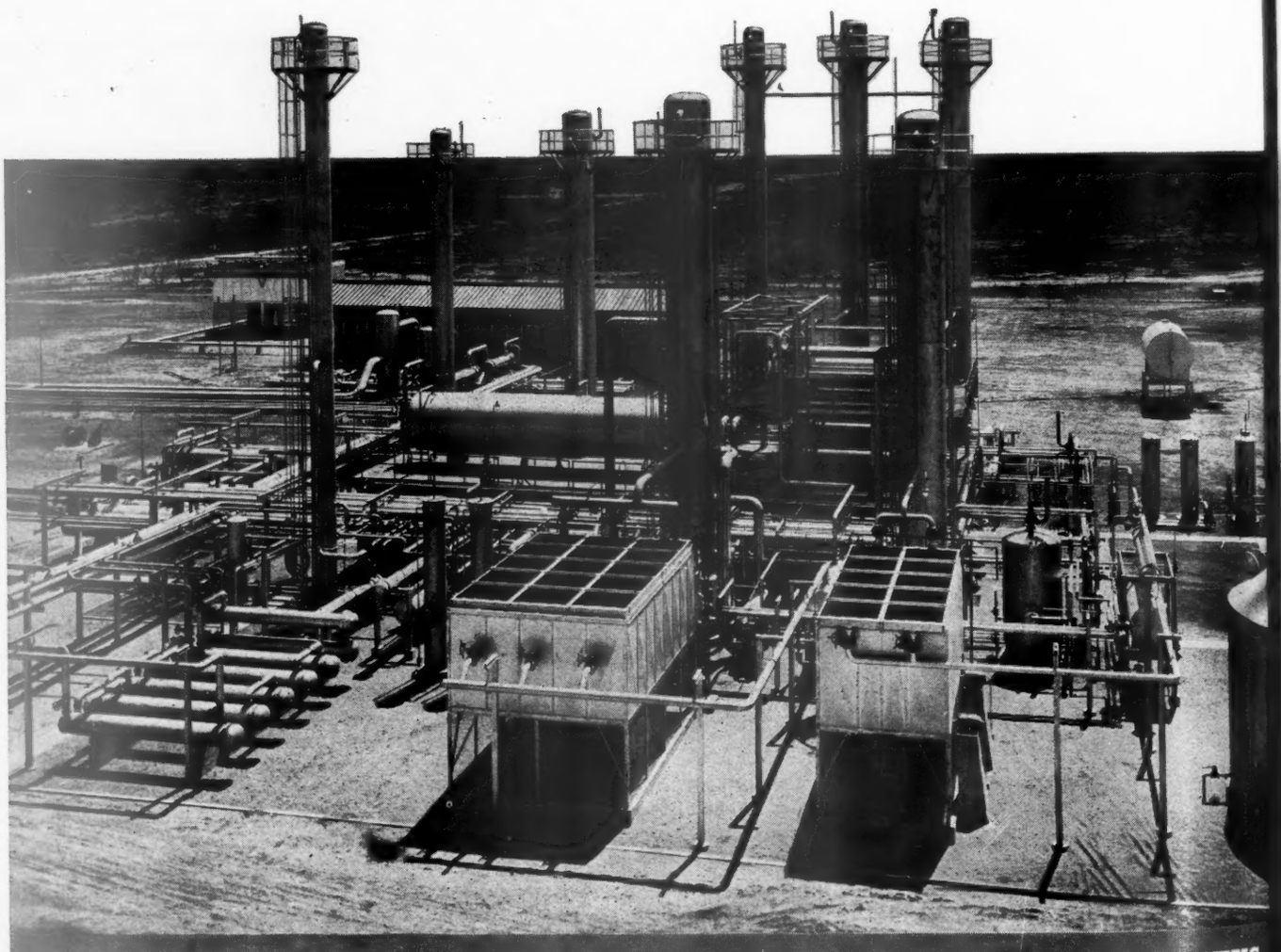

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Whenever *you* need heat transfer apparatus, consult the G-R engineers to be sure of best results.

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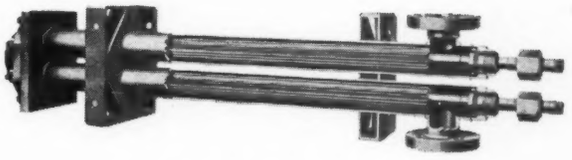

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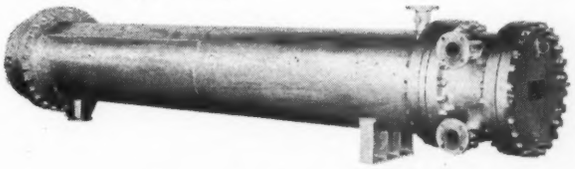

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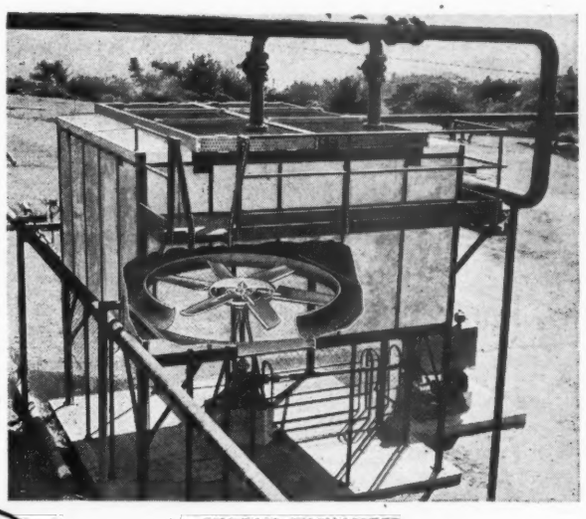

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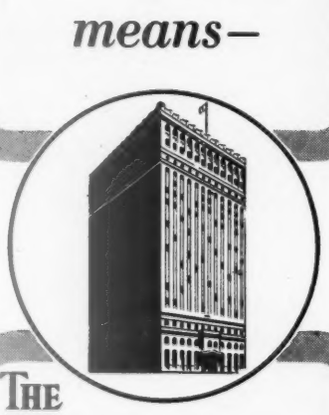

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Oil Fellowship Grants Total $25,500 To Texas U.

Petroleum industry fellowship and research grants totaling more than $25,500 to the University of Texas got formal acceptance from the University Board of Regents. The Texas Mid-Continent Oil and Gas Association has sent the University Bureau of Business Research $2500—the first installment of a $7500 grant for an economic survey of the natural gas industry, with special reference to Texas.

Humble Oil and Refining Company contributed 4 fellowships; The Texas Company, Magnolia Petroleum Company, Pan American Refining Corporation, Sun Oil Company, and Ethyl Corporation contributed 1; Shell Oil Company and Stanolind Oil and Gas Company, 2.

For its petroleum industry training program, the University's Industrial and Business Training Bureau received $2960 from the Association of Oilwell Drilling Contractors.

Statement of the Ownership, Management, Circulation, etc., Required by the Acts of Congress of August 24, 1912, and March 3, 1933, of

THE PETROLEUM ENGINEER

Published monthly at Dallas, Texas, for October 1, 1950.

State of Texas, County of Dallas, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared W. T. Bryan, who, having been duly sworn according to law, deposes and says that he is the Business Manager of

THE PETROLEUM ENGINEER

and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to-wit:

1. That the names and address of the publisher, editor, managing editor, and business managers are:

Publisher: The Petroleum Engineer Publishing Company, P. O. Box 1589, Dallas, Texas.

Editor: K. C. Sclater, P. O. Box 1589, Dallas, Texas.

Managing Editor: Ernestine Adams, P. O. Box 1589, Dallas, Texas.

Business Manager: W. T. Bryan, P. O. Box 1589, Dallas, Texas.

Advertising Manager: T. J. Crowley, P. O. Box 1589, Dallas, Texas.

Stockholders holding 1 per cent or more of total amount of stock: W. T. Bryan, T. J. Crowley, W. L. Love and K. C. Sclater, all of Dallas, Texas.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustees or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has an interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

W. T. Bryan, Business Manager.

Sworn to and subscribed before me this 28th day of September, 1950.

[Seal] Edwina H. Cameron

(My commission expires June 1, 1951.)

British Oil Equipment Hits All Time High

Exports of British oilfield industry equipment in 1950 will be valued around £85 million, as against £10 million in 1939. This expansion of oilfield plant production is the result of a conscious policy of replacement of overseas plant by British plant, in the interests of dollar economy, wherever possible. It also marks the growth of reciprocal agreements between American and British engineering companies whereby the American "Know-how" has been linked to British technical and production facilities to overcome the dollar shortage.

Other factors in the situation are the expansion of refinery work in Britain involving huge sums of refinery plant, and the devaluation of sterling. This has diverted buyers to the U.K. The Council of British Manufacturers of Petroleum Equipment has been largely responsible for stimulating interest and organizing production of suitable plant. The Council has added over 450 member firms since 1943—an indication of the growth of interest and production. By far the major part of the output goes abroad, and even U.S. firms are taking British plant.

Sinclair Holds Educational Meet

Sinclair Refining Company was host to more than 75 scientists, engineers, and college professors at its research and development laboratory in Harvey, Illinois recently. This is the first of a series of one day educational regional conferences, sponsored by the Diesel Engine Manufacturer's Association, that will be held throughout the country. The purpose of the meeting was to exchange ideas between mechanical engineering professors, particularly those interested in diesel engine design and operation, with the Sinclair staff and each other. During the day there were technical talks by Sinclair engineers on the development of diesel lubricants and diesel fuels directed toward improving the performance of the diesel engine.

CORROSION ENGINEER

New large oil pipeline company requires two corrosion engineers immediately to set-up and maintain corrosion protection on a 1,000-mile oil pipeline. Two years experience minimum required. Should be familiar with all phases of field and office work. Include full details professional experience first letter. Address Box 118, c/o THE PETROLEUM ENGINEER, P.O. Box 1589, Dallas, Texas.

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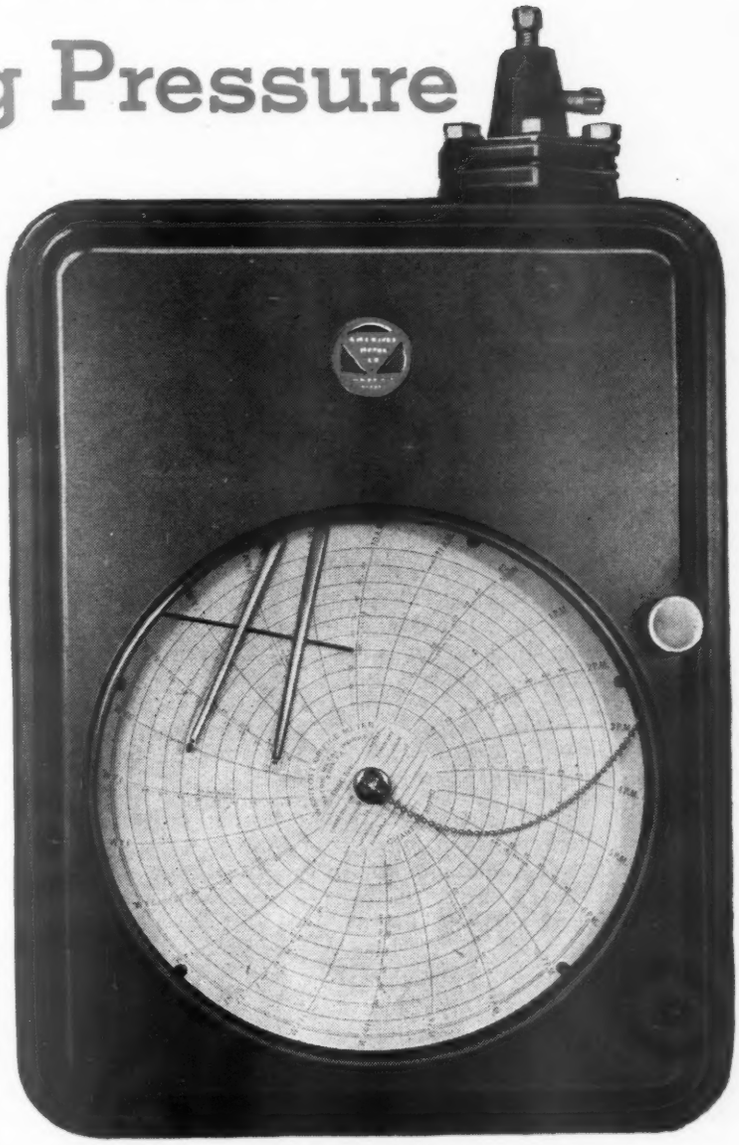

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Union type seal tube connections permit interchanging 20", 50", 100" and 200" ranges. Other ranges up to 800" available

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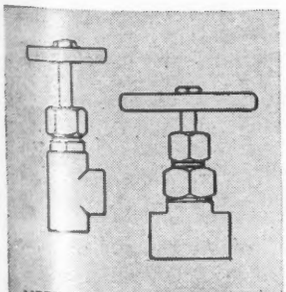
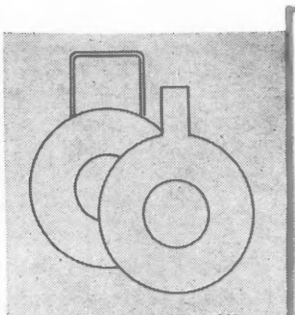


NEEDLE VALVES, SCREWED AND UNION BONNET
(Specification Sheet)



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NEWS

Oil Men Pledge Support To Nation's Defense Plan

Pledging its wholehearted support to the Federal government's defense program, the Texas Mid-Continent Oil and Gas Association brought to a close its 31st annual convention held in Dallas, Texas recently. In the final business session, however, the more than 500 members attending, adopted two concisely written resolutions, stating, in fact, that the Association would continue to oppose the Federal Power Commission.

The defense cooperative theme was included in the resolution which read, "The Association pledges its full support to the government in making this nation secure and in maintaining its high standards of living."

Two resolutions aimed at the FPC condemned the commission for its proceeding against Phillips Petroleum Company, stating the case was "unwarranted." The other resolution condemned the Commission's order No. 154, which "usurped congressional rights in its effort to exempt the production and gathering of natural gas from commission jurisdiction."

The Association will hold its 1951 convention in Beaumont, Texas.

Mines Bureau Reopens Texas Helium Plant

Because of steadily increasing demands for helium for both military and civilian uses, the Bureau of Mines has reopened the Amarillo, Texas, helium plant for a limited production, Secretary of the Interior Oscar L. Chapman has reported. Production at the Amarillo plant was suspended in August 1945 after a decline in military demands for helium. Since then the plant has been operated only 4 months and has been in complete standby status since September 1946. Meanwhile, the Bureau's Exell, Texas, plant, with a rated production capacity of 60,000,000 cu ft of helium annually, has supplied all needs of Federal agencies and private consumers, Director James Boyd of the Bureau of Mines said. The Amarillo plant was opened in 1929 and has a rated output of 36,000,000 cu ft of helium annually.

Oil Firms Raise Salaries

Employees of major oil companies throughout the nation have been given a 6 per cent salary increase during the past month. Minimum increase was $17 per month and applied to all employees. Increases were given to help defray higher income taxes and living costs.

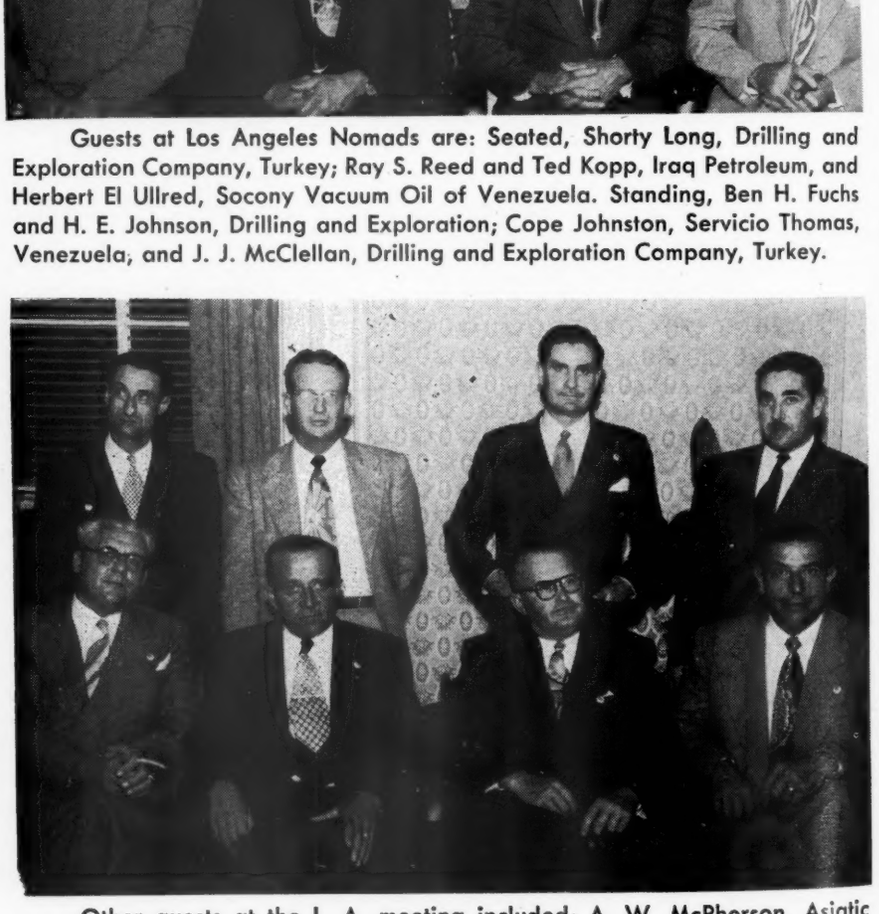
Decker, Smith Speak At L. A. Nomads Meeting

Elmer Decker and Jack Smith, both recently returned from Europe, led some fine discussion on the foreign market for oil tool equipment at a recent Los Angeles Nomads meeting. Pertinent remarks by A. W. McPherson, materials man for Shell at Maracaibo, added to the interest.

Pan American Airway exhibited one of the finest travel films ever made, showing scenery on a trip around South America by air. Spectacular color photography made this film an outstanding presentation. Parts made on Chilean beauty spots were particularly attractive.

Harry Hester was inducted a new member of the clan by Ted Forsyth. Harry was escorted to the rostrum by Jim Hughes and Hi Cassidy. After numerous remarks and questions designed to defame the character of Hester, he was duly congratulated and brought into the group. The other four guys who should have been similarly inducted, were afraid to show up.

Guests at Los Angeles Nomads are: Seated, Shorty Long, Drilling and Exploration Company, Turkey; Ray S. Reed and Ted Kopp, Iraq Petroleum, and Herbert El Ullred, Socony Vacuum Oil of Venezuela. Standing, Ben H. Fuchs and H. E. Johnson, Drilling and Exploration; Cope Johnston, Servicio Thomas, Venezuela, and J. J. McClellan, Drilling and Exploration Company, Turkey.



Other guests at the L. A. meeting included: A. W. McPherson, Asiatic Petroleum, Venezuela; W. E. Childers, Mene Grande Oil; A. F. Driskill and R. E. Lorenz, Iraq Petroleum Corporation. Standing, Jesse Roberts and Vernon E. Clayton, Iraq Petroleum Corporation; W. R. Young, National Supply Export, London, and Jorge Pacheco, Fomento, Chile.

PERSONALS

A. P. Frame, vice president in charge of manufacturing and research for Cities Service Oil Company, has been named to direct the Petroleum Administration for Defense's aviation gasoline program. **Thomas L. Apjohn,** Socony-Vacuum Oil Company, was appointed assistant director of the aviation gasoline program, and **Donald P. Heath,** also of Socony-Vacuum, will make the third man on the three-man committee.

Frame has held various positions with Cities Service, since joining the company in 1924. He has been vice president in charge of marketing and research since 1945. He was director of the refining division of the Petroleum Administration for War from 1944 to 1945 and has since served as vice chairman of the Military Petroleum Advisory Board.

Apjohn is a graduate of Massachusetts Institute of Technology and has worked for Socony-Vacuum since 1936. He served as an aviation gasoline specialist on the Petroleum Administration for War from 1942 to 1945. Heath joined Socony-Vacuum upon graduation from Purdue University in 1940. He has been engaged in product development work since 1945, and at present is research associate in charge of development work on motor gasoline, aviation gasoline, and jet fuels for Socony-Vacuum.

G. B. Shea, acting supervising engineer of the Bureau of Mines petroleum field office at San Francisco, California, has been appointed chief of the Fuels Technology division for Region 3, designated as the Southwestern Region, with headquarters at San Francisco.

Under the Bureau's regional reorganization plan and the appointment of **Harold C. Miller,** formerly supervising engineer of the petroleum and natural gas branch at San Francisco as regional director Region 3, all Bureau activities in oil and gas in the States of California and Nevada, henceforth will be centered in the Fuels Technology Division, which Shea will head.

Shea has been with the Bureau since 1928, with the exception of 4 years spent in Washington, D. C. and 8 months in 1946-47, when he was loaned to the National Resources Section GHQ, SCAP in Tokyo, Japan, to assist the occupation forces in rehabilitating the Japanese petroleum industry. Shea has been continuously in the San Francisco petroleum field office, engaged in petroleum production research.

Millard K. Neptune was appointed manager of Continental Oil Company's foreign department, to be special Washington, D. C., representative of the company. He will also continue as manager of the foreign department. In his new position Neptune will assist all departments in the company's business with federal agencies situated in the nation's capital, L. F. McCollum, president, announced.

Harold L. Lawler, operating engineer with Stanolind Oil and Gas Company, has been transferred to the Slaughter gasoline plant near Sundown, Texas. He was formerly operating engineer at the Elk Basin gasoline plant, Elk Basin, Wyoming. Lawler received his BS degree in chemical engineering from the University of Colorado in 1941.

Fletcher F. Farrar, formerly petroleum engineer with the Texas Company at Salem, Illinois has resigned and is now associated with Slivka and Son Oil Producers at Mount Vernon, Illinois.

Howard C. Pyle has resigned the presidency of Continental Consolidated Corporation and has opened offices in the Pacific Finance Building, Glendale, California, as a consultant in petroleum engineering and geology. Pyle is a former chief production engineer for Union Oil Company of California.

He was given a special petroleum assignment in Washington during the last war and was transferred to General Eisenhower's staff in the European Theater in January 1944. Following the war he was elected vice president in charge of oil industry loans by the Bank of America. He became president of Continental Consolidated Corporation in 1947.

Robert L. Kelley has been appointed office manager of the Evansville, Indiana, production division of Sun Oil Company. He succeeds **Charles R. Perkins** who recently was elected secretary-treasurer of the Mid-Valley Pipeline Company, Longview, Texas.

Kelley joined the Sun Oil Company at Evansville in January 1942, and moved up through various accounting subdivisions until his appointment as first assistant to the office manager in January of this year.

E. L. Steiniger was recently named president of Venezuelan Petroleum Company and of its operating subsidiary Sinclair Oil and Refining Company. **H. R. Kunhardt, Jr.,** former president, is taking a leave of absence. Steiniger has been the active representative of Sinclair in Venezeula for a number of years and held the post of executive vice president.

E. J. Mulvihill, Jr., former vice president has been promoted to executive vice president. **W. C. Paton,** who has been district manager in the Santa Barbara field, has been transferred to the Caracas office as vice president and assistant to Mulvihill in charge of operations.

R. B. Anderson was named head of the Texas Mid-Continent Oil and Gas Association for the fourth time at the Association's convention in Dallas, Texas. Among those renamed were **Charles E. Simons,** Dallas, vice president and general manager, and **Eugene McElvaney,** Dallas, treasurer. McElvaney, vice president of the First National Bank in Dallas, was presented with scroll in testament to his long service with the Association. **R. Clay Underwood,** Wichita Falls, was named district vice president for the North Texas district.

Foreign guests of Tulsa Nomads. Attending the Tulsa, Oklahoma Nomads fall party recently were: William B. Barriman, Creole Petroleum Corporation, Jusepin, Venezuela; Walter Parker and N. E. Williams, Arabian-American Oil Company, who are in the U. S. hiring personnel for service in Arabia.

▸ **B. Brewster Jennings,** president of the Socony-Vacuum Oil Company, Inc., has been appointed chairman of the 1951 Greater New York Fund campaign. This was announced by Earl B. Schwulst, president of the fund whose campaign, held in the spring of each year, helps support 423 health and welfare agencies in New York's five boroughs. Jennings has been associated with Socony-Vacuum since 1920, following World War I overseas service as an ensign on a submarine chaser and graduation from Yale.

▸ **Richard J. Cook** of Oil City, Pennsylvania, has been appointed Mid-West field service representative for the Pennsylvania Grade Crude Oil Association, according to W. C. Wenzel, association executive manager. His headquarters will be in Chicago, Illinois, where the association has had a representative for many years. He succeeds **B. E. Youkers** who resigned to establish his own service station business at Butler, Pennsylvania.

Upon graduation from Oil City Senior High School in 1946, Cook entered the U. S. Air Force and was stationed at Randolph Field, Texas. He was assigned to administrative work and attained the rating of staff sergeant. He was honorably discharged in 1949. He has completed a business management course at Welch's Business College in Oil City.

▸ **Minor S. Jameson, Jr.,** who has been economist for the Independent Petroleum Association of America since 1937, has ben named assistant

Minor S. Jameson, Jr.

to the president of the association. Born in Worcester, Massachusetts, Jameson moved to Washington, D. C., where he attended public schools. He was graduated from Massachusetts Institute of Technology in 1934 with a degree in engineering and business administration. For 3 years following graduation he was in the economics division of the Federal Trade Commission in Washington.

▸ **J. Howard Marshall,** president of Ashland Oil and Refining Company, was recently appointed as a consultant by Interior Secretary Oscar L. Chapman to assist him on legal and administrative matters in connection with the petroleum defense program. **J. R. Parten** also has been appointed by Chapman to serve in a consulting capacity. Both Marshall and Parten were members of the Petroleum Administration for War during World War II. Marshall is a graduate of Haverford College and Yale.

▸ **L. E. Frensley** has been elected as comptroller of Magnolia Petroleum Company. He succeeds the late **S. R. Harwell** in that position. Frensley came to the comptroller's office in July 1935. Subsequently he spent 4 years in tax and accounting work with Socony-Vacuum Oil Company organizations in New York and South America, returning to Magnolia in September 1941.

Warren M. Albert has been named as assistant comptroller of Magnolia. Albert, who has been chief of the comptroller's system and planning section, has been with the organization 22 years, having begun with the company as a clerk in the producing accounting department.

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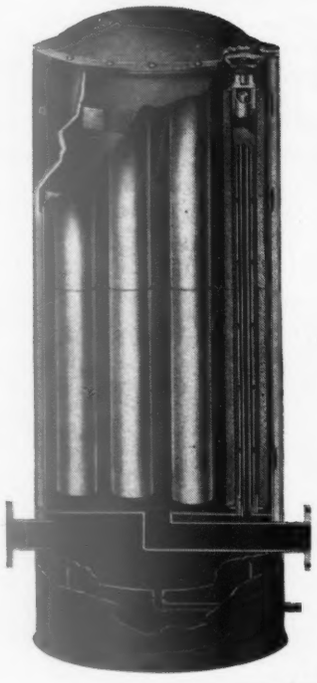

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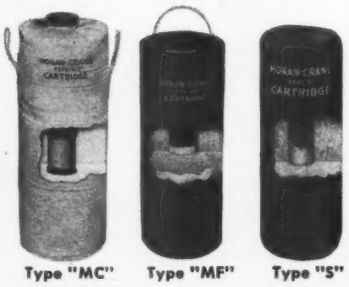

Type "MC" Type "MF" Type "S"

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Honan-Crane Type "MF" Cartridge

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BIBLIOGRAPHY—Classified list of important papers for 1949 - 1950

Classification by Authors

Matthews, C. S. (Hurd, C. O. and Souders, Mott, Jr.), Entropy and Heat of Formation of Hydrocarbon Vapors, Ind. Eng. Chem. 41, 1048-56, May, 1949.

Matthews, F. W. H. (Parsons, D. F.), The Copper-Strip Test—A Study of Current Methods of Interpretation and an Examination of Proposed New Procedures, API, Mid-Year Meeting, Division of Refining, Hotel Cleveland, Cleveland, Ohio, May 1-4, 1950.

Mattikow, M., Refining Fatty Oil with Liquid Propane, J. Am. Oil Chem. Soc. 27, 11-14, Jan., 1950.

Mattocks, E. O., Safe Handling of LP-Gases, Butane-Propane News 11, 58-70, Dec., 1949.

Mattocks, E. O. (Rugh, K. W.), LP Gas Sales—1949, Chem. Eng. 57, 141, Feb., 1950.

Maxted, E. B., Studies on the Nature of Chemisorptive Bonds. I. Some Observed Regularities, J. Chem. Soc., 1987-91, Aug., 1949.

May, Donald T. (Canan, Thomas C.), Reservoir Engineering in Secondary Recovery, North Texas Oil & Gas Association, 20th Annual Meeting, Kemp Hotel, Wichita Falls, Texas, March 25, 1950.

Mayland, B. J. (Hays, G. E.), Synthesis Gas Production From Methane, Chem. Eng. Progress 45, 452-8, July, 1949.

Mayland, B. J. (Poettmann, F. H.), Equilibrium Vaporization Constants of High Boiling Hydrocarbons, Pet. Refiner 28, 101-12, July, 1949.

Meadow, J. R. (White, T. A., Desulfurization of Heptane Solutions of Organic Sulfur Compounds, Ind. Eng. Chem. 42, 925-9, May, 1950.

Mears, T. W. (Howard, F. L. and Pomerants, Philip), Analysis of Triptene Residue, Research Nat'l. Bur. Standards 42, 617-32, June, 1949.

Mears, T. W. (Dussinger, C. S., Fookson, Abraham, Howard, F. L., Pomerantz, Philip, and Rich, E. H.), Syntheses and Properties of Two Olefins, Six Paraffins, and Their Intermediates, J. Research Nat'l. Bur. Standards 44, 299-311, March, 1950.

Meholin, G. L., Producing Possibilities of Lower Pennsylvanian of the Panhandle Portion of the Anadarko Basin, AAPG, Mid-Continent Regional Meeting, Skirvin Hotel, Oklahoma City, Okla., Jan. 12-13, 1950.

Meisinger, E. E. (Ipatieff, V. N. and Pines, Herman), Isomerization Accompanying Alkylation. V. Reaction of 4-Methylcyclohexene with Benzene in the Presence of Hydrogen Fluoride, J. Am. Chem. Soc. 72, 2772-4, June, 1950.

Meissner, H. P. (Seferian, R.), P-V-T Relations of Gases' AIChE, Boston Regional Meeting, New Ocean House' Swampscott, Mass., May 28-31, 1950.

Melpolder, F. W. (Dunn, E. B., Taylor, R. C. and Young, W. S.), Description and Application of a Dual Automatic Potentiometric Titrimeter, API, Mid-Year Meeting, Division of Refining, Hotel Cleveland, Cleveland, Ohio, May 1-4, 1950.

Meriwether, H. T. (Fuzek, J. F. and Smith, H. A.), Catalytic Hydrogenation of Terpenes, J. Am. Chem. Soc. 71, 3765-99, Nov., 1949.

Meryman, H. T., Focusing Device for the Electron Microscope, Rev. Sic. Instruments 20, 955, Dec., 1949.

Merz, J. H. (Waters, W. A.), Oxidation of Aromatic Compounds, J. Chem. Soc., 2427-33, Oct., 1949.

Mesrobian, R. B. (Metz, D. J. and Tobolsky, A. V.), Low Temperature Autoxidation of Hydrocarbons: The Phenomenon of Maximum Rates, J. Am. Chem. Soc. 72, 1942-52, May, 1950.

Metz, D. J. (Mesrobian, R. B. and Tobolsky, A. V.), Low Temperature Autoxidation of Hydrocarbons: The Phenomenon of Maximum Rates, J. Am. Chem. Soc. 72, 1942-52, May, 1950.

Meyers, H. S. (Fenske, M. R. and Quiggle, Dorothy, Efficiencies of Fractionating Columns, Ind. Eng. Chem. 42, 649-53, April, 1950.

Michel, J. M. (Hager, K. F.), Corrosion-Inhibited Fuels, Ind. Eng. Chem. 41, 2616-22, Nov., 1949.

Migaux, M. L., Consideration of the Techniques of Oil and Natural Gas Prospecting, UNSCCUR, Lake Success, N. Y., Aug. 17-Sept. 6, 1949.

Milberger, E. C. (Becker, H. C., Levin, H. and Uhrig, K.), Determination of Water in Hydrogen Chloride, Anal. Chem. 21, 1192-4, Oct., 1949.

Miller, A. J., The Accuracy of Low Temperature Fractional Analysis of Liquid Hydrocarbon Mixtures, NGAA, 29th Annual Convention, Texas Hotel, Fort Worth, Tex., April 24-26, 1950.

Miller, A. L. (Miller, P. C.), The Background, Education and Selection of Engineers, AIChE, Boston Regional Meeting, New Ocean House, Swampscott, Mass., May 28-31, 1950.

Miller, C. C. (Dyes, Alvin B. and Hutchinson, C. A., Jr.), Estimation of Permeability and Reservoir Pressure from Bottom Hole Pressure Build-Up Characteristics, AIME, Petroleum Branch Fall Meeting, Plaza Hotel, San Antonio, Tex., Oct. 5-7, 1949.

Miller, C. F., Operation of API Oil-Water Separator at Trenton Refinery, API, Mid-Year Meeting, Division of Refining, Hotel Cleveland, Cleveland, Ohio, May 1-4, 1950.

Miller, C. H. (Thompson, H. W.), Ultraviolet Absorption of Fluorinated Aromatic Hydrocarbons, J. Chem. Phys. 17, 845-6, Sept., 1949.

Miller, G. H. (Russell, W. W.), Catalytic Hydrogenation of Carbon Dioxide to Higher Hydrocarbons, J. Am. Chem. Soc. 72, 2446-54, June, 1950.

Miller, Pat, Development of a Corrosion Control Program, AGA, 31st Annual Convention, Palmer House, Chicago, Ill., Oct. 17-20, 1949.

Miller, P. C. (Miller, A. L.), The Background, Education and Selection of Engineers, AIChE, Boston Regional Meeting, New Ocean House, Swampscott, Mass., May 28-31, 1950.

Miller, R. H., Property Accounting for Natural Gas Pipe Line and Production Plant, AGA, 31st Annual Convention, Palmer House, Chicago, Ill., Oct. 17-20, 1950.

Milligan, William B. (Brooks, Francis R., Lykken, Louis, Hazelton, R. Nebeker), Analysis of Gases by Absorption and Combustion, ACS, 115th Meeting, Division of Petroleum Chemistry, San Francisco, Calif., March 27-April 1, 1949.

Mills, J. R., Jr., The Value of Vocational Training in the Pipe-Line Industry, API, 29th Annual Meeting, Stevens Hotel and Palmer House, Chicago, Ill., Nov. 7-10, 1949.

Milne, A. A. (Barwell, F. T.), The Measurement of Kinetic Boundary Friction with Reference to Specifications for Lubricating Oils, J. Inst. Pet. 35, 455-74, July, 1949.

Milner, O. I., Analysis of Fluorinated Hydrocarbons, Anal. Chem. 22, 315-7, Feb., 1950.

Minckler, R. L., Oil and the Public, API, Spring Meeting of the Rocky Mountain District, Division of Production, Gladstone Hotel, Casper, Wyo., April 13-14, 1950.

Minkin, Jean A. (Bailey, E. D. and Rouse, P. E., Jr.), Factors Affecting the Precision of Viscosity Measurements with the Torsion Crystal, API, Mid-Year Meeting, Division of Refining, Hotel Cleveland, Cleveland, Ohio, May 1-4, 1950.

Minor, C. K. Jones (Retailliau, Edmond R. and Richards, Harold A., Jr.), Precombustion Reaction in the Spark Ignition Engine, SAE, Annual Meeting, Book-Cadillac Hotel, Detroit, Mich., Jan. 9-13, 1950.

Mizushima, San-Ichiro (Simanouti, Takehito), Raman Frequencies of n-Paraffin Molecules, J. Am. Chem. Soc. 71, 1320-24, April, 1949.

Mizushima, San-Ichiro (Okazaki, Hiroatsu, Equilibrium Ratio of Rotational Isomers of n-Pentane, J. Am. Chem. Soc. 71, 3411-12, Oct., 1949.

Mizushima, S. (Kuratani, K., Morino, Y. and Simanouti, T.), Infrared and Raman Spectra of Hexachlorethane, J. Chem. Phys. 17, 838-9, Sept., 1949.

Mizushima, S. (Simanouti, T.), Raman Spectra of Solid N-Paraffins, J. Chem. Phys. 17, 1102-6, Nov., 1949.

Mohler, F. L. (Bloom, E. G., Lengel, J. H., Wells, E. J. and Wise, C. E.), Doubly Charged Ions in Mass Spectra, J. Research, Natl. Bur. Standards 42, 369-78, April, 1949.

Mohler, F. L. (Bloom, E. G., Dean, H. M., Wells, E. J., Williamson, Laura, and Wise, C. E.), Mass Spectra of Nonanes, J. Research Nat'l. Bur. Standards 44, 291-7, March, 1950.

Mohler, F. L. (Dibeler, V. H., Reese, R. M. and Wise, C. E.), Introduction of Measured Liquid Samples into the Mass Spectrometer, J. Research Nat'l. Bur. Standards 44, 215-20, March, 1950.

Mohler, F. L. (Bloom, E. G., Wells, E. J. and Wise, C. E.), Metastable Transitions in Mass Spectra of Hydrocarbons, J. Research Nat'l. Bur. Standards 43, 65-70, July, 1949.

Mohler, F. L. (Bloom, E. G., Wells, E. J., Williamson, L. and Wise, C. E.), Mass Spectra of C5Hg Isomers, J. Research Nat'l Bur. Standards 43, 533-6, Dec., 1949.

Momen, S. A. (Newitt, D. M.), Synthesis of Aliphatic Acids, J. Chem. Soc. 2945-8, Nov., 1949.

Monroe, G. S. (Fischer, L.E. and Ipatieff, V. N.), Low Temperature Hydrogen Production, Ind. Eng. Chem. 42, 92-4, Jan., 1950.

Montgomery, H. A., Modifications in LPG Test Methods, NGAA, 29th Annual Convention, Texas Hotel, Fort Worth, Tex., April 24-26, 1950.

Moody, G. B., Symposium on Possible Future Oil Provinces of North America—Pacific Coast States and Nevada, AAPG, Annual Meeting, Stevens Hotel, Chicago, Ill., April 24-27, 1950.

Moore, A. E., Automobile Polishes, Cleaners, and Waxes, Chem. Inds. 66, 385-92, March, 1950.

Moore, B. L., 762-Vs. 440-Volt Distribution Systems, API, 29th Annual Meeting, Stevens Hotel and Palmer House, Chicago, Ill., Nov. 7-10, 1949.

Moore, E. B., Decolorization of Tallow by Liquid-Liquid Extraction, J. Am. Oil Chemists' Soc. 27, 75-80, March, 1950.

Moore, G. E. (Parks, G. S.), Thermodynamic Data for n-Hexadecane and n-Dodecylcyclohexane, J. Chem. Phys. 17, 1151-3, Nov., 1949.

Moore, Stanely, (Schabarum, Bruno), Selection of Drill Stem, AAODC, 9th Annual Meeting, Baker Hotel, Dallas, Tex., Sept. 19-21, 1949.

Moorhead, J. B., Geology of the Fort Worth Basin, AAPG, Mid-Continent Regional Meeting, Skirvin Hotel, Oklahoma City, Okla., Jan. 12-13, 1950.

Morgan, F. (Dory, E. G. and McDowell, J. M.), Improvements in the X-Ray Saturation Technique of Studying Fluid Flow, AIME, Petroleum Branch Fall Meeting, Plaza Hotel, San Antonio, Tex., Oct. 5-7, 1949.

Morgan, W. E., Jr., Dry Chemical Extinguisher Effective on Oil Fires, Pet. Processing 4, 998, Sept., 1949.

Morino, Y. (Kuratani, K., Mizushima, S. and Simanouti, T.), Infrared and Raman Spectra of Hexachlorethane, J. Chem. Phys. 17, 838-9, Sept., 1949.

Morris, H. B. (Gilbertson, D. L.), Diesel Fuel from Oil Shale, Diesel Progress 15, 42-3, Sept., 1949.

Morrison, A. B. (Levin, H. and Reed, C. R.), Micromethods for Petroleum Products, ACS, 115th Meeting, San Francisco, California, March 27-April 1, 1949.

Morrison, J. A. (Durand, E. J. and King, R. O.), High Compression Ratio and Thermal Efficiency, Can. J. Research 27 (F), 435-49, Nov., 1949.

Morse, R. D. (Ballou, C. O.), The Uniformity of Fluidization—Its Measurement and Use, AIChE, Boston Regional Meeting, New Ocean House, Swampscott, Mass., May 28-31, 1950.

Morton, Tom E. (Hassebroek, W. E., A Year of Hydrafrac in North Texas, North Texas Oil and Gas Association, 20th Annual Meeting, Kemp Hotel, Wichita Falls, Tex., March 25, 1950.

Mosteller, W. C., Transmission-Line Type Storage—Capacity Calculations and Cost, AGA, Natural Gas Spring Meeting, Hotel Mayo, Tulsa, Okla., May 8-9, 1950.

Mougey, H. C., (Anglin, A. B. and Georgi, Carl W.), Field Experience with 5W Motor Oil, API, 29th Annual Meeting, Stevens Hotel and Palmer House, Chicago, Ill., Nov. 7-10, 1949.

Moulton, Harold G., America's Potentialities and How to Realize Them, Texas Mid-Continent Oil and Gas Association, Houston, Tex., Oct. 13-14, 1949.

Mueller, M. H. (Clark, G. L.), Spectrophotometric Evaluation of Engine Lubricants, Anal. Chem. 21, 1485-90, Dec., 1949.

Mugdan, Martin (Young, D. P.), Catalytic Hydroxylation of Unsaturated Compounds, J. Chem. Soc., 2988-3000, Nov., 1949.

Mulcahy, M. F. R., High-Temperature Oxidation of Hydrocarbons, Trans. Faraday Soc. 45, 537-41, June, 1949.

Mumford, S. A. (Phillips, J. W. C.), Physical Properties of Some Aliphatic Compounds, J. Chem. Soc., 75-84, Jan., 1950.

Munhall, W. V. (Barnebey, H. L. and Lynch, E. P.), Design and Construction of a Fischer-Tropsch Pilot Plant, ASME, Process Industries Division and Pittsburgh Mechanical Engineering Conference, Hotel William Penn, Pittsburgh, Pennsylvania, April 24-27, 1950.

Murphy, M. T. (Duggan, A. C.), Pyrolysis of Butadiene, J. Am. Chem. Soc. 71, 3347-9, Oct., 1949.

Murray, Christopher, A., Thermofor Catalytic Cracking Gas Plant Corrosion Survey, NACE, South Central Regional Meeting, Adolphus Hotel, Dallas, Tex., Oct. 3-4, 1949.

Murray, Grover E., Geosynclinal Deposits in Central Gulf Region of United States, AAPG, Annual Meeting, Stevens Hotel, Chicago, Ill., April 24-27, 1950.

Murrell, John Natural Gas Reserves and What the Term Includes, SGA, Fifth Annual Short Course in Gas Technology, Texas College of Arts and Industries, Kingsville, Tex., May 29-31, 1950.

Musgrave, W. K. R. (Smith, F.), Fluorination of Hydrocarbons, Part 1, J. Chem. Soc. 3021-6, Nov. 1949.

Muskat, Morris (McDowell, J. M.), An Electrical Computer for Solving Phase Equilibrium Calculations, AIME, Petroleum Branch Fall Meeting, Plaza Hotel, San Antonio, Tex., Oct. 5-7, 1949.

LAUGH WITH BARNEY

The bank president rushed into the bank looking for the cashier, only to find he was not at his window. When he inquired as to his whereabouts, he was informed that the cashier was at the races.

"Gone to the races during business hours?" cried the president.

"Yes, sir, it's his last chance to make the books balance."

* * *

Boy: One more kiss, darling.

Girl: We won't have time. Father will be home in an hour."

* * *

The girl on the bus was reading about birth and death statistics. Suddenly she turned to a male beside her and said, "Do you know that every time I breathe a man dies?"

"Very interesting," he returned, "why don't you try Sen-Sen?"

* * *

An old farmer wrote to Sears, Roebuck and Company as follows:

"Please send me one of them gasoline engines you show on page 785 and if it's any good I'll send you a check for it."

He received the following reply from the firm:

"Please send us the check and if it's any good we'll send you the engine."

Girls, when they went out to swim
Once dressed like Mother Hubbard.
Now, they have a better whim . . .
They dress more like her cupboard.

* * *

Perfume Salesgirl to Blonde: "Just a word of advice. Don't use this stuff if you're only bluffing."

* * *

A boy left the farm and got a job in the city. He wrote a letter to his brother who elected to stick to the farm, telling of the joys of city life, in which he said:

"Thursday we autoed out to the Country Club where we golfed until dark. Then we motored to the Beach for the week-end."

The brother on the farm wrote back:

"Yesterday we buggied to town and baseballed all the afternoon. Then we went to Ned's and pokered until morning. Today we muled out to the cornfield and ge-hawed until sundown. Then we suppered and piped for awhile. After that we staircased up to our room and bedsteaded until the clock fived."

* * *

There are three sides to every question—your side, his side, and to hell with it.

A beggar was walking along the street led by a dog with a large sign around its neck reading "Help the Blind." A gentleman passing by dropped a quarter into the beggar's outstretched hat.

"Say," he cried as he was turning away, "was that a half dollar I gave you?"

"No," answered the beggar, "only a quarter."

"So," said the gentleman, "you are not blind after all."

"Oh, no," the beggar replied, "It's the dog that's blind, not me."

* * *

Two travelers arrived at the hotel and were shown a rather dingy room.

"What," said one, "does this pigsty cost?"

Promptly the proprietor replied:

"For one pig, two dollars; for two pigs, three dollars."

* * *

Nellie bought a new dress,
It was so very thin,
She asked me how I liked it,
So I answered with a grin:
"Wait till the sun shines, Nellie."

* * *

Customer: I want them comfortable, but I also want them smart and good looking.

Shoe salesman: I know what you mean—large inside and small outside.

* * *

A clergyman paused in the middle of his sermon to eye a group of disturbers with evident disapproval. "I am always reluctant to expose those who misbehave during services," he said at length, "because of an experience I had some years ago. A young man who sat before me was laughing, talking and making grimaces. I was annoyed and rebuked him severely. Later I was told I had made a grave mistake. The man I had reproved was an idiot."

* * *

At 5 a.m., little Johnny awoke and asked his mother to tell him a story. "Sh-h-h," soothed Mother, "any minute now your daddy will be home and tell us both one."

* * *

Customer: I'd like a dollar dinner, please.

Ritzy Waiter: Yes, sir. On white or rye sir?

* * *

Army Doctor: Have you any physical defects?

Draftee: Yes sir. No guts.

* * *

Policeman: How did you knock him down?

Motorist: I didn't. I pulled up to let him go across and he fainted.

OIL AND GAS TRADE NEWS

Technical Oil Tool To Enlarge Plant Facilities

Technical Oil Tool Corporation, Ltd., recently opened a new section of several thousand square feet of floor space at its Los Angeles, California, manufacturing plant. New machine tools including Swiss automatics, turret lathes, and gear burnishers have been installed to increase the productive capacity of the plant. Peters explained that this expansion was necessary not only to handle the production of the present TOTCO instrument, but for the new instruments that should be on the market later this year. Peters said the company is doing some government development work.

Technical Oil Tool's Los Angeles plant.

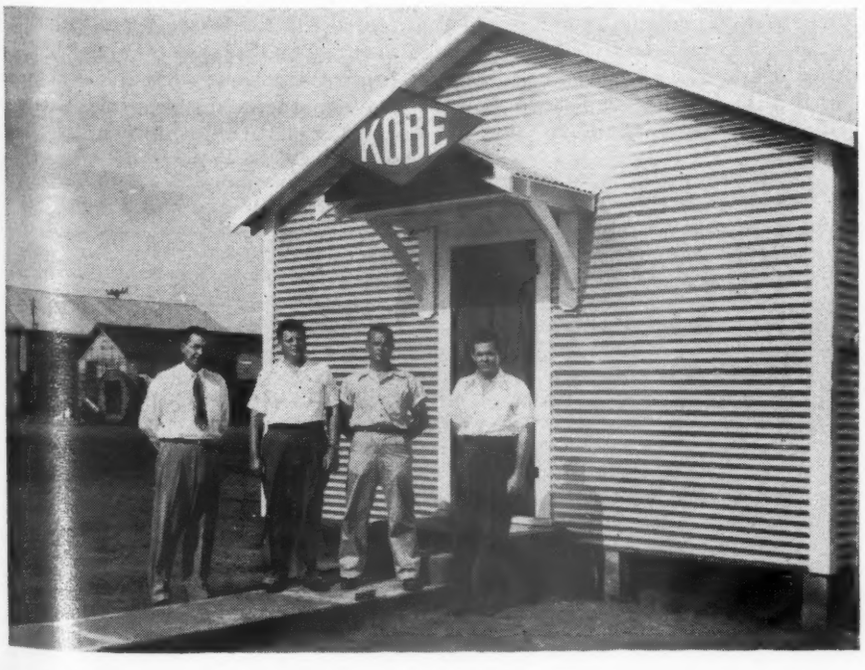
Distributors Named

The Cleco Division of the Reed Roller Bit Company, Houston, Texas, has announced the appointment of Ensminger Company, 57 Wood Street in Wilkes-Barre, Pennsylvania, as distributors of Cleco products in that area. In addition to handling the full line of Cleco pneumatic tools, the Ensminger Company, will maintain complete stocks of Cleco parts and accessories for the convenience of customers in the Wilkes-Barre territory.

Brandenburg Has New Address

Louis A. Brandenburg Advertising has moved its Tulsa, Oklahoma, office to suite 200, Ritz Building. The company has asked that correspondents address mail to P. O. Box 1403 in Tulsa, as the post office box is checked several times a day.

Kobe Opens Warehouse, Office. In a further expansion of its field service facilities in Southern Oklahoma, Kobe, Inc., has opened an office and warehouse at Healdton. The men responsible for the direction of Kobe's activities in this area are, Charlie Edwards, district manager and Bill Wallace, Jim Oefinger, and Ken Rinker, representatives.



Haworth Named Manager

P. S. Jones, vice president in charge of sales, Cutler-Hammer, Inc., Milwaukee, Wisconsin, has announced the appointment of R. A. Haworth as manager of its Dallas, Texas, district sales office. Haworth joined Cutler - Hammer in 1934 upon his graduation from the University of Wisconsin with the degree of electrical engineer. After serving in its headquarters sales department, he was transferred to the New York district sales office and later to the Philadelphia district sales office. Upon the opening of its Baltimore, Maryland, sales office in 1936, Haworth was appointed manager and held that position until his Dallas appointment. Haworth will supervise the Tulsa, Midland, and Houston offices.

R. A. Haworth

New Orleans Office In New Location

Raybestos-Manhattan, Inc., has announced the removal of its New Orleans, Louisiana, office and warehouse from 1009 Camp Street to 920 Calliope Street. The new facilities will enable the company to serve customers in that area with a more complete stock of belting, V-belts, hose, other industrial rubber products, packings, and asbestos textiles.

The Petroleum Rectifying Company's office, laboratory, service, and manufacturing facilities at 1390 E. Burnett Street, Long Beach, California. A new office building has been constructed, and existing buildings modernized.

Holds Golden Anniversary

The Youngstown Sheet and Tube Company held a Golden Anniversary open house at its Indiana Harbor plants October 11. The event marked the 50th anniversary of the company that was organized by a small group of eastern Ohio business leaders in the fall of 1900. From its original capitalization of $600,000, the company has grown to one of the nation's major steel producers, capitalized at more than $250,000,000 and employing more than 26,000 persons.

Special tours were arranged through the plant, including a trip through the open hearth department, blooming mill, billet mill, bar mill, etc.

National Supply Gets New Alice, Texas, Store

The National Supply Company has announced the opening of a new store at Alice, Texas. The store will replace the one that had been operating at Falfurrias. The new location will place The National Supply Company in a better position to serve the area that had been assigned to the store at Falfurrias, as well as the counties of Live Oak, Bee, Jim Wells, Kleberg, and the northern portions of Kenedy and Brooks counties, the company said.

Large stocks of miscellaneous material will be carried at the new Alice store, National Supply said. They plan in the near future, to increase the inventory of heavy machinery there because they feel that they are now in a more centralized position for serving new areas that had been far removed from existing National Supply Company stores. The new store is under the direct supervision of V. H. Gardner, district manager for National Supply and R. T. Wilkerson, Sr., is store manager.

Utah Branch Opened

Chiksan Company, Brea, California, has established sales headquarters for the Rocky Mountain area in Salt Lake City, Utah, with B. P. Ragsdale in charge. Formerly a member of Chiksan's engineering department, service representative, and sales engineer in the Southern California territory, Ragsdale will handle sales and service in Chiksan, WECO, Anchor, and Okadee products. Chiksan's Rocky Mountain headquarters were formerly in Denver, with Al Myers as sales representative.

Tulsa Office Set Up

General American Transportation Corporation announces the opening of a new plate and welding division office in Tulsa, Oklahoma. J. D. Camp will represent General American for the sales of all fabricated equipment as well as Wiggins conservation structures and Wiggins gasholders. Mr. Camp's office will be in the First National Building. He has been associated with General American since completing duty in the U. S. Navy.

Mid-Continent Store Opened in New Mexico

Mid-Continent Supply Company has again expanded its growing network of branch stores with the opening of a new store at 118-120 South Miller Avenue, Farmington, New Mexico. In a statement on the opening of operations in Farmington, Ken W. Davis, president and general manager of Mid-Continent, also announced the appointment of E. L. Tedder as store manager. Tedder was formerly store manager at Hobbs.

Other personnel at Farmington includes Field Salesman H. T. Branum who was transferred from Snyder, Texas; F. A. Dieterman, also from Snyder; B. K. Morgan from the Hobbs store; B. F. Sealy of the store in Kermit, Texas; and new employees Jess Stewart and M. D. Cogdell. Operating under the West Texas-New Mexico Division of Mid-Continent, the new store will be under the supervision of Division Manager T. P. Tarwater and R. L. McAnally, division sales manager.

Foxboro Company Announces Two Recent Office Openings

The Foxboro Company has announced two new branch office addresses bringing the total of its domestic offices to 39, of which three include branch factory facilities. Newest addition to the list is the branch office at 214 W. 10th Street, Wilmington 1, Delaware, under the managership of Kenneth L. Barton, a 25-year man with The Foxboro Company. Earlier this year a Foxboro Company office was opened at 225 S. 5th Street, Minneapolis 2, Minnesota, with Robert C. Cahill as resident engineer. Foxboro interestes have been represented in the Minneapolis-St. Paul area for many years by a well known firm of engineers; but the mounting volume of business prompted the opening of a full-scale branch office.

National Supply store in Alice, Texas.

D. J. Mooney, Jr. P. E. Warner W. G. Shepard A. A. Kruse, Jr. Denny Gordon

Sales Divisions Set Up

The Ohio Injector Company of Wadsworth, Ohio, in a move designed to integrate sales services at the distributor and customer levels, announces the establishment of 5 major sales divisions, each functioning under a field manager who reports to H. G. Smith, vice president in charge of sales.

New sales divisions and the respective managers are:

New York division (New York City, southern Connecticut, and northern New Jersey)—Daniel J. Mooney, Jr., New York. Atlantic division (Mobile, Alabama, to Portland, Maine, excepting New York Division area)—Paul E. Warner, Philadelphia, Pennsylvania. Central division (Minneapolis, Minnesota, to Buffalo, New York, St. Louis, Missouri to Pittsburgh, Pennsylvania)—W. G. Shepard, Wadsworth. Mid-Continent division (Denver, Colorado to Kansas City, Kansas, El Paso, Texas to New Orleans, Louisiana)—A. A. Kruse, Jr., Dallas, Texas. Pacific division (Los Angeles, California to Seattle, Washington)—Denny Gordon, San Francisco, California. The company's representatives in the division areas will report directly to the division sales manager.

Natasco Buys Gage Firm

The Natasco Company of Tulsa, Oklahoma, has purchased the patents, shop, and equipment of the Nelson Automatic Gauge Company, also of Tulsa. The latter company manufactures a complete line of gaging equipment, which permits accurate gaging of an unlimited number of tanks, from distant control stations, with a maximum of three seconds per tank.

Plans for quantity manufacture by the Natasco Company are now progressing rapidly and the Nelson automatic gages will soon be available in all oil production and refining areas.

New Orleans Sales Office

A new division sales office in New Orleans, Louisiana, was opened recently by Magnet Cove Barium Corporation, Houston, Texas. The office will be at 705 Richards Building and L. D. Jones, assistant sales manager for Magcobar, will be in charge of the new office. Prior to his joining the Magcobar organization, Jones was a district sales manager of Beaumont Cement Sales Company and is a former toolpusher for Bateman Drilling Company.

L. D. Jones

Magcobar has other sales offices at Houston, Tulsa and Corpus Christi, and maintains stock points with nearly 300 Magcobar dealers from Canada to the Gulf Coast.

Gets New Houston Address

Foote, Cone and Belding advertising agency has announced that it has moved to new and expanded quarters. The new address will be 2116 Fannin Street, Houston 2, Texas. Telephone number is ATwood 8561.

Electric Water Heaters. Beginning production on the second million units at the Kankakee, Illinois, Works of A. O. Smith Corp. with a Smith 3-Way, electric water heater, F. S. Cornel, right, division manager, accepts congratulations from J. F. Donnelly, marketing director. The Smith 3-Way, offering three volumes of hot water in one tank, is the newest of the Permaglas and Duraclad line to be introduced by A. O. Smith.

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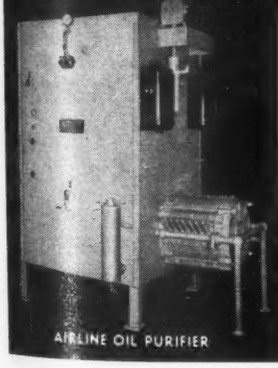
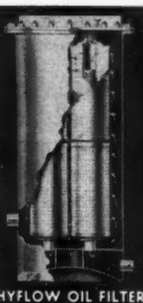


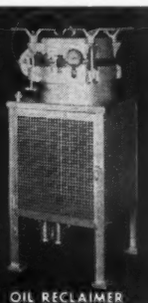
AIRLINE OIL PURIFIER

HILCO

OIL PURIFICATION EQUIPMENT



HYFLOW OIL FILTER



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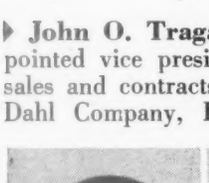
TRADE PERSONALS

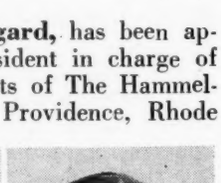
Robert L. Coe, president, Chase Brass and Copper Company, Incorporated, has been elected chairman of the board, and **Richard C. Diehl,** former general manager of the Steubenville, Ohio, plants of Wheeling Steel Corporation, president. Coe began his business career with Chase in 1917 and, after spending several years in the mills, joined the sales force, later becoming vice-president in charge of sales. He became president of Chase on January 1 of this year. Diehl spent 7 years with Armco Steel Corporation at its Butler, Pennsylvania, and Middletown, Ohio, plants. He has been associated with Wheeling Steel Corporation for 15 years, serving successively as assistant chief metallurgist, chief metallurgist, assistant general manager and, most recently, as general manager of its Steubenville, Ohio, plants.

Frank D. Smith has been elected as a vice president of International Cementers, Inc., Long Beach, California. He became affiliated with ICC in September of 1943 as a sales representative in the Los Angeles basin. In January 1945 he was advanced to the position of California division manager, and in June 1949 became assistant general manager of the company.

John O. Tragard, has been appointed vice president in charge of sales and contracts of The Hammel-Dahl Company, Providence, Rhode



J. O. Tragard



Maurice MacDonald

Island. For 20 years, Tragard has been sales executive and legal counsel of the Foxboro Company, and for 4 years with the Fulton Sylphon division of Robertshaw-Fulton Controls. He is a graduate of Northeastern University and Harvard College. **Maurice MacDonald** was made vice president and manager of engineering. MacDonald has been associated with Johns-Pratt Company and Bussman Company of St. Louis, Missouri. He joined M. W. Kellogg Company in 1932 and for the past 8 years was chief engineer in charge of instrumentation and control.

J. Chester Ray is appointed sales manager, dealer brands, tire division, United States Rubber Company. In this capacity he will head the sales organization for U. S. tires and Fisk-Gillette tires divisions. Ray began his career with U. S. Rubber as a stockroom boy in Pittsburgh and became manager of the Pittsburgh branch in 1922. Following this he held key assignments in both U. S. tires and Fisk tires sales.

Wilson O. Green is named to succed Ray as sales manager, U. S. Tires Division. Green is a graduate of the University of North Carolina and Baltimore College of Commerce and became associated with U. S. Rubber in 1935 as assistant to the district manager at Charlotte, North Carolina. His most recent assignment has been that of sales manager of the Fisk-Gillette tires division.

Arthur G. Westlund is appointed sales manager, Fisk-Gillette tires division succeeding Green. Westlund has been serving as Assistant Sales Manager of Fisk-Gillette Tires, a position he assumed last July. **John A. Boll** is appointed to the position of assistant sales manager, Fisk-Gillette tires division.

R. P. Mase has been appointed as the Southwest sales representative of the petroleum refining division of Arthur G. McKee and Company, Cleveland, Ohio. Mase will be situated in Tulsa. He has been an active petroleum engineer for the past 25 years, and for the past 10 years has been chief engineer of the Jones and Laughlin Supply Company, engineering and construction division, Tulsa, Oklahoma.

James Herrick, vice president of Cardwell Manufacturing Company, has resigned. He has been with Cardwell since 1940 and sold Cardwell rigs in the Gulf Coast before the war. During the war he served in the 8th Air Force in England as chief of maintenance.

Since the war he has run the Cardwell New York export office for two years and made two trips through Europe and the Middle East and Far East oil fields. More recently he has been in charge of advertising and sales promotion in Wichita.

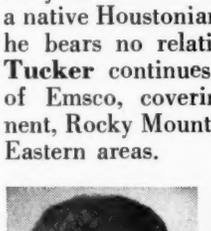
Paul Courtney, recently appointed vice president of Emsco Derrick and Equipment Company and former manager of the Houston plant, has been appointed vice president and general manager of sales for all Emsco products, excluding D+B sales. Courtney who has been with Emsco since 1938 is stationed at Houston, Texas. At the same time, it was announced that **S. A. Martin,** former assistant plant manager, succeeds Courtney as manager. He joined Emsco in 1927 as a helper in the shops.

Paul Courtney

S. A. Martin

F. M. Martin

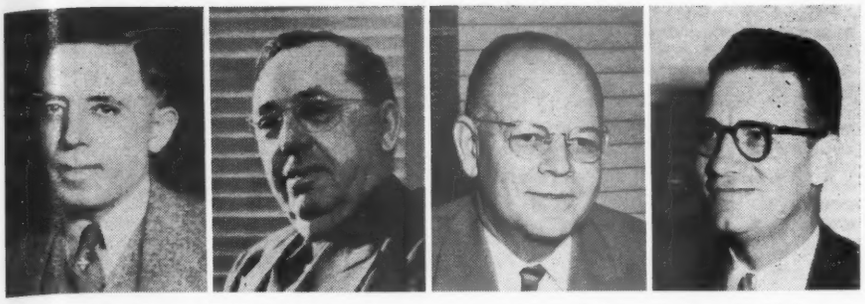
F. M. Martin, manager of jobber sales, has assumed duties as assistant plant manager of the Houston plant. He joined Emsco in 1932, and while a native Houstonian like S. A. Martin, he bears no relation to him. **J. T. Tucker** continues as sales manager of Emsco, covering the Mid-Continent, Rocky Mountain, Canadian, and Eastern areas.



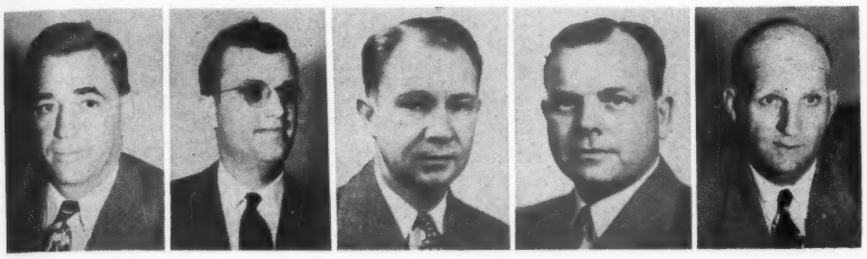
H. C. Thornton

A. R. Brown

H. C. Thornton, 11-year veteran with United Supply and Manufacturing Company, has been named as assistant district manager of Oklahoma with headquarters at Elk City. Thornton, until his recent promotion, has been manager of United's store at Elk City, Oklahoma. **A. R. Brown,** for the last 6 years store manager of the Seminole, Oklahoma store for United, has also been promoted to assistant district manager of Oklahoma with headquarters in Seminole.



Erle P. Halliburton W. R. McLendon L. D. Campbell L. B. Meaders



R. R. Emery W. Tapper W. D. Owsley G. Kilgore R. G. Kelly

John V. Jirasek has been appointed manager of sales activities in the petro-chemical industries for Worthington Pump and Machinery Corporation. He holds a chemical engineering degree from the University of Prague and undertook post graduate work at Sorbonne, Paris. In 1940 he joined the Worthington Pump and Machinery Corporation as special representative to the petroleum and chemical industries. Prior to his association with Worthington, Jirasek was connected with the M. W. Kellogg Company in the United States and with its European representative, the Companie Technique des Petroles in Paris, and the Sharples Corporation in Philadelphia.

Ben F. Rummerfield, has been manager of seismic operations for Century Geophysical Corporation, Tulsa, Oklahoma. Rummerfield is a graduate of the Colorado School of Mines. He joined Seismograph Service Corporation in 1940 and worked throughout the Mid-Continent and Rocky Mountain areas. In 1945 he was transferred to Venezuela as geophysical supervisor.

S. S. Stewart has been named vice president in charge of purchasing for Mack Manufacturing Corporation, it was announced recently by E. D. Bransome, chairman and president. Stewart was formerly purchasing agent for the manufacturing division of Air Reduction Sales Corporation. He had been associated with that company since 1934. Prior to that he was with Wilson Welder and Metals Company, which was later purchased by Air Reduction.

Kenneth G. Lundie, Johnston Pump Company, Los Angeles, California, was elected vice president in charge of sales, and **Perry Brown** was elected vice president of engi-

K. G. Lundie P. H. Brown

neering. Brown has been chief engineer at Johnston and Lundie has been sales manager. Both men have been in the vertical turbine pump industry for many years, with Johnston Pump Company and other manufacturers.

William R. Reid, chairman of the board of The Torrington Company, died September 16th, at Torrington, Connecticut, following a short illness. He had been with The Torrington Company for 50 years, 22 of which he had served as president. For the past 4 years, he had been chairman of the board.

James E. Barthmaier has been named as district manager of diesel engine sales and service for Enterprise Engine and Machinery Company's New England territory, with headquarters at Boston, Massachusetts. Simultaneously, Enterprise announced the appointment of **Hugh H. Goodwin** as sales engineer for its New York branch.

Wallace R. McClendon was recently named president of Halliburton Oil Well Cementing Company, it was announced by Erle P. Halliburton, chairman. The new president had served since 1942 as Halliburton's vice president in charge of field operations. Retiring president **John C. Halliburton,** associated with the company since 1932 and president since 1947, will devote full-time to his ranching activities near Duncan, Oklahoma. Following "Mac" McClendon's army service in World War I, he was connected with the Gulf Refining Company, Houston, Texas. After the incorporation of the Halliburton company in 1924, he headed the company's Gulf Coast operations at Houston until 1942, when he moved to Duncan as vice president.

Other promotions announced were: **L. D. Campbell,** vice president and secretary treasurer, was elected a member of Halliburton's board of directors. **L. B. Meaders** succeeded W. R. McClendon as vice president in charge of field operations. **Ralph R. Emery** was elected vice president in charge of foreign operations. **Wilfred Tapper** was elected vice president of electrical well services. **W. D. Owsley** was elected vice president and technical advisor to executive officers. And **Grover Kilgore** was elected vice president in charge of sales and advertising.

R. G. Kelly, Midland, Texas, who has been superintendent of Halliburton's West Texas-New Mexico division, was promoted to the position of regional manager of the central region. The new regional manager fills the position vacated by **L. B. Meaders.**

John C. Diehl has been elected president of American Meter Company. Diehl was born in New Oxford, Pennsylvania and educated at Gettysburg College and Massachusetts Institute of Technology. In 1919 he joined the staff of the American Meter Company as an engineer, and was elected to the post of chief engineer in 1929. In 1934 Diehl was made vice president.

J. C. Diehl

Diehl is a member of the American Gas Association and Gas Appliance Manufacturers Association, and is the author of numerous technical articles and books on gas measurement. **Norton McKean,** president of the American Meter Company since 1941, has resigned due to his health.

George S. Badger has been named representative in the Canadian oil fields for Rector Well Equipment Company, Inc., Fort Worth, Texas. A resident of Edmonton, Alberta, Canada, Badger has been engaged in sales work in the Canadian oil fields for the past year. Prior to residing in Edmonton, Alberta, Badger was engaged in equipment sales in California, Utah, Colorado, and New Mexico. He has also done sales and service work in the oil fields of the Middle East and India.

G. S. Badger

He will be in charge of sales and service for Rector casing and tubing heads, Rector fulbore cementing, Rectorseal, etc., in Canada.

R. Chris Nitschke has joined Rockwell Manufacturing Company as a project engineer on the company's petroleum products. No newcomer to petroleum products and equipment, Nitschke was formerly employed by Standard Vacuum Oil Company as assistant chief engineer. From 1941 to 1943, he headed his own consulting engineering operation in New York City, which was dissolved when he entered the armed service as a petroleum specialist. Most of his 3 years service was spent in the European Theatre with the Engineers Corps and the Quartermaster Corps. Nitschke spent 1946 in South America as a project engineer for M. W. Kellogg. Later he was with A. G. McKee Company.

Archie E. Weingard has been named manager of production for American Meter Company. His headquarters will be at the Erie plant, Pennsylvania. He first became associated with the American Meter Company in 1947 as supervisor of methods, later being made assistant to the vice president. Weingard is a graduate of the General Electric Technical Engineering School, where he studied engineering, designing, management, and analytic subjects. Following his graduation he spent 16 years at General Electric serving in various capacities.

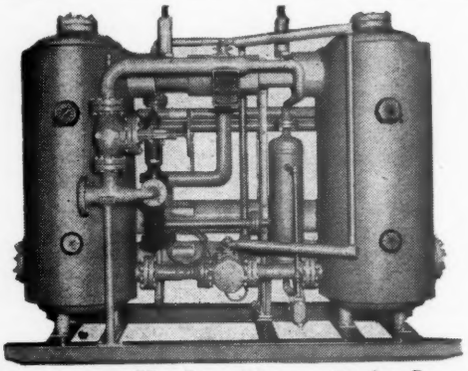
A. E. Weingard

Thomas H. McConnell, Jr. was named sales promotion manager and advertising manager of Vulcan Rubber Products, Inc., Brooklyn, New York in charge of all new business. McConnell joined the company in 1948. He was formerly with the Standard Oil Company (New Jersey) and the Standard Vacuum Oil Company, where he traveled extensively in Europe, Africa and the Orient.

T. H. McConnell

G. H. Slack, Continental Supply Company, Dallas, Texas has been named manager of the Casper, Wyoming store. He was former sales representative at that point. **John J. Dean,** store manager at Harvey, Louisiana, has been transferred to Alice, Texas to serve in the same capacity. **Cooper Vaughn** has replaced **H. B. Harris** as store manager at McAllen, Texas, the latter being transferred to the North Texas area.

W. R. Everett has been appointed manager of the Post, Texas store, being transferred from Pampa, Texas. He is succeeded by **J. B. Patterson.**



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R. M. Frink was appointed Detroit plant manager of the Wolverine tube division of Calumet and Hecla Consolidated Copper Company, Incorporated. Frink, throughout his tenure with the company, has served in managerial capacities related to both production and sales at the Detroit plant. Replacing Frink, as customer relations manager, will be **V. A. Zatell.** With the company since 1937, Zatell has supervised the production planning department and was recently appointed to the divisional control group. **E. G. Wojack,** who has been responsible for the coordination of production planning at the company's Decatur, Alabama, plant, has been promoted to production planning manager and will replace Zatell in that capacity and as a member of the divisional control group.

David G. Golden, Continental Supply Company, assistant store manager at Pratt, Kansas, has been transferred to Harvey, Louisiana as store manager.

John Lundahl has been appointed to the newly created position of sales representative-at-large by the Detroit diesel engine division of General Motors Corporation. Lundahl will be on special assignment, working with the regularly assigned sales representatives throughout the country. He will also be available when needed to assist in the engineering of special GM Diesel engine installations in the industrial field.

John Lundahl

Robert P. Hazzard has joined M. N. Aitken Company, Houston, Texas as a sales engineer. He will sell Robinson orifice fittings. He has had many years experience with the Girdler Corporation, handling instrumentation, design, and operation of pilot plants after graduating from Drexel Institute in Philadelphia, Pennsylvania.

R. P. Hazzard

Clarence J. Stubble has been appointed assistant manager of National Supply Company's Eastern division with headquarters at Pittsburgh, Pennsylvania. At the same time the company made known the appointment of **J. C. Woods** as assistant manager, Eastern division, with headquarters at Toledo, Ohio. Stubble has been with National Supply since 1934 when he joined them at Bolivar, New York as a store clerk. He has held the positions of store manager and field salesman and had been a district manager before moving to his new position. Woods joined The National Supply Company at Fort Worth, Texas in 1944. Previously, he had been resident manager for the Bethlehem Supply Company and has been associated with the oil industry since 1926.

Clarke A. Polk, formerly assistant general manager of Sterling Packing and Gasket Company has been appointed sales manager of the McFarland Manufacturing Corporation, Houston, Texas manufacturers of chemical injectors, McFarland hydrostatic testing pumps, and blowout preventer closing units. Polk, who has been in the oil industry equipment manufacturing business since 1933, is well known throughout the industry.

C A. Polk

Milton W. Gregory has joined Glass Fibers Inc., Waterville, Ohio as sales manager of the bonded mat division. He had been a sales engineer for the DeVilbiss Company of Toledo for 5 years, before that he was employed by the E. I. DuPont Company as process engineer supervisor at their Indiana Ordnance Works after spending 2 years as a chemical process engineer with the Firestone Tire and Rubber Company.

M. W. Gregory

R. D. Redner has been named sales representative of the Detroit diesel engine division of General Motors. In his new capacity, Redner will promote the sale of General Motors Series 71 and new 275 hp "6-110" diesel engines through the division's distributor organization in Minnesota, North and South Dakota, Iowa, Nebraska, Western Missouri, and Kansas. Redner, a graduate of the University of Michigan, served a major oil company in the Netherlands West Indies before joining Detroit diesels' sales department in 1948.

Clayton L. McDougall has been appointed sales and engineering representative to The Cooper-Bessemer Corporation's Odessa, Texas office. McDougall is a graduate engineer from the University of Cincinnati and has been associated for over 6 years with this engine and compressor builder at its headquarters plant in Mt. Vernon, Ohio. He will be under the direction of **Arthur W. Abel, Jr.,** branch manager.

C. L. McDougall

Lee Allan Swem was appointed vice president in charge of the newly formed international division of Foster Wheeler Corporation (New York). The international division will be responsible for foreign business of the Corporation and will coordinate the activities of subsidiary companies in Canada, England, and France. Swem joined Foster Wheeler Corporation in 1936 as patent counsel and elected vice president in charge of legal department in 1948.

L. A. Swem

John H. Burch was appointed sales manager of the Detroit, Michigan district of the Wickwire Spencer steel division of The Colorado Fuel and Iron Corporation. An alumnus of Purdue University, Burch was a member of the Varsity football team for 3 years. After his graduation in 1934, he became associated with the Continental Steel Company and also A. O. Smith Company of Milwaukee.

His headquarters will be at the Detroit district sales office. He succeeds **L. A. Watts,** who will now devote his full efforts in the capacity of sales manager of the wire and pig iron and semi-finished steel departments of Wickwire Spencer steel.

Vernon H. Haston, a native of Kansas who has been associated with Mid-Continent Supply Company since 1947, is the company's new district manager at Great Bend, Kansas. The promotion of Haston to his new position coincided with the announcement that the company's district office has been moved from Wichita, Kansas, to Great Bend. Mid-Continent now is represented in Wichita by **J. M. Woods,** who is in charge of the company's sales office, and **A. R. Tune,** sales representative.

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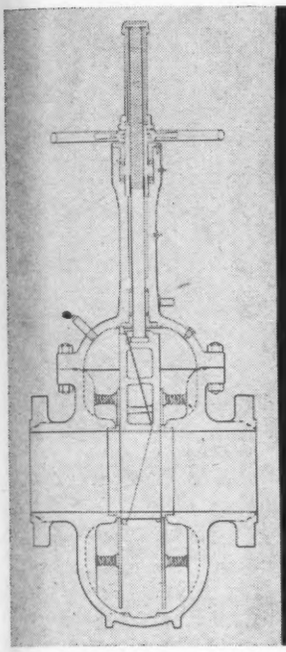

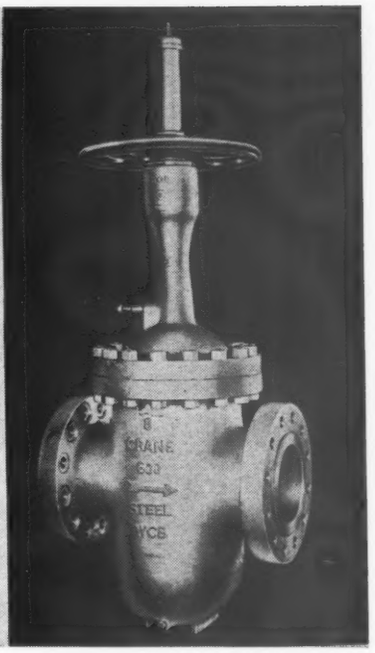

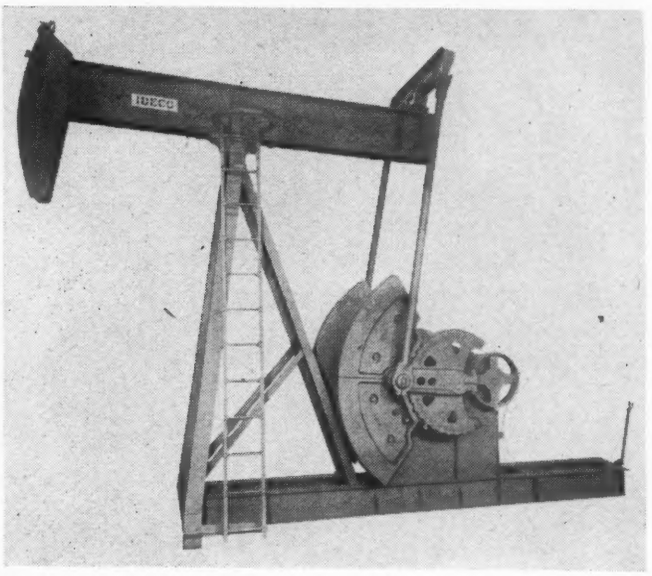

Ideco pumping unit.

These are very brief descriptions of new items manufacturers have put on the market but you need more information to appreciate advance in design, materials, performance, etc. Send the coupon below for details.

(1) Pipe Line Valves

A new line of Class 600 cast steel pipe-line valves is announced by Crane Company, Chicago, Illinois. The new conduit type valves are available with either flanged or butt-welding ends in full port or venturi type. Size range is 2 through 30 in. They are recommended for service on crude oil, finished product, and gas lines, with suitable trim being furnished for the service. Straight-through ports in body and straight ports in disc provide unrestricted flow when valve is open. Parallel, double-wedging disc seats tightly in either open or closed position. Lubricant in body is retained by patented spring-actuated plates pressing sides of disc.

(2) Pumping Unit

The International Derrick and Equipment Company of Dallas, Texas, announces its new F16-DA114 pumping unit. This unit has a polished rod load capacity of 15,900 lb and a peak torque capacity of 114,000-in. lb. It features the Ideco wheel type counterbalance crank, a rigid 4 legged samson post, a new sturdy, welded subbase under the reducer and clamp type pitman connections. The speed reducer is fitted with Herringbone gears and all shafts are carried on roller bearings.

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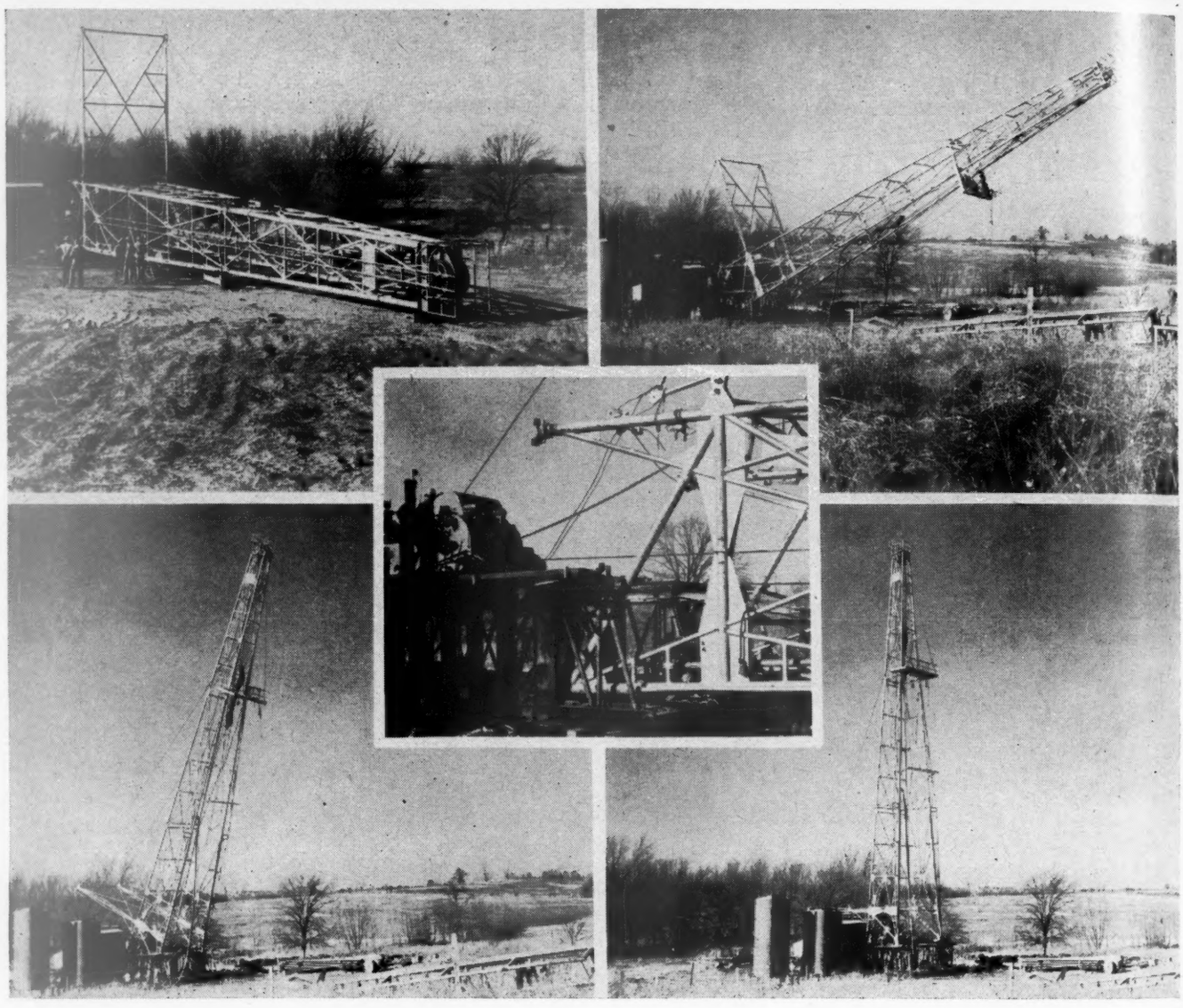


(3) Steel Derricks

A new portable steel derrick with a streamlined rigging method and prime safety features was announced recently by Oil Well Supply Company, United States Steel subsidiary, Dallas, Texas. Named the 128-B, the new tubular steel derrick is erected directly from the ground. It was designed primarily for use on the higher substructures demanded in today's deeper well drilling to permit more elaborate blowout preventer equipment. The new model does not require gin pole trucks to raise it to floor level. It "walks" itself up onto the derrick floor, employing two pivot points instead of one and utilizing both front and rear legs in the 90 deg swing into vertical position or back to the lowered position. (See above.)

After it is assembled on the ground, the frame slides along a built-in guide to a hinge point at the bottom of the derrick substructure. There circular shoes on the front legs slip over a tubular shaft.

(4) Tool Joints

Newest addition to the American Iron and Machine Works Company line of rotary tool joints is a "Flash Welded" tool joint. This tool joint is now available for all popular sizes of API drill pipe; with or without hard metal bands; and in a choice of 18 deg or square shoulder design. American Iron and Machine Works, Oklahoma City, has installed modern flash weld electrical machinery, along with the latest testing equipment, to insure the highest possible quality in its "Flash Welded" tool joints.

(5) Sulfuric Acid

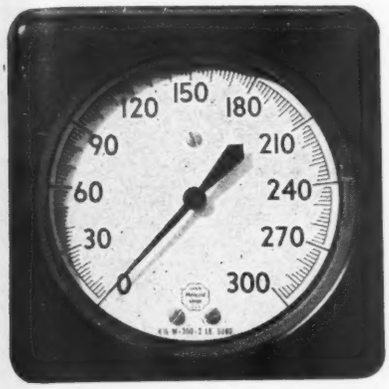
Chemical Construction Corporation, New York, has developed a new way to make sulfuric acid, which eliminates 7 major items of equipment, W. N. Porter, president of the firm, announced recently. The new process is the result of the development of the following units: (1) quench converter, (2) bubble absorbers, using evaporative cooling, (3) low cost Pease-Anthony venturi sulfuric acid mist eliminator. Traditional components of conventional contact installations that are no longer needed include: a) drying tower, b) gas filter, c) heat exchanger between primary and secondary converter, d) sulfur trioxide cooler, e) acid coolers, f) acid transfer pumps and piping, and g) dilution system.

(6) Aneroid Barometer

Wallace and Tiernan Products, Inc., Belleville, New Jersey has developed a laboratory type aneroid barometer indicator for atmospheric pressure. As the instrument case is pressure tight, it may be connected directly to laboratory apparatus to measure absolute pressure in a test set-up. The range is 26 to 31.5 in Hg and the scale length is 3 times that of a mercurial barometer.

(7) Gage Case

Helicoid Gage Division, American Chain and Cable Company, Inc., Bridgeport, Connecticut, announces a new gage case for flush mounting gages on panels. The new square case



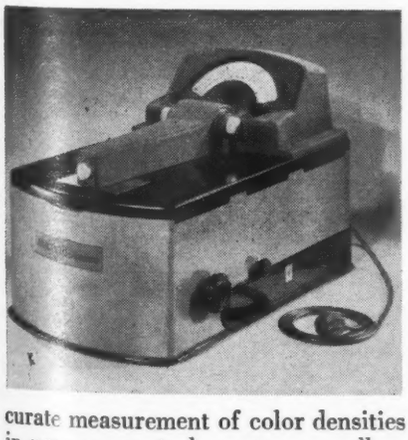
has the same bolt circle and the same round cut-out in the panel as standard round flush cases of the same dial size. The width of the square front flange is considerably less than the diameter of the conventional round front flange.

(8) Crawler Tractor

The American Tractor Corporation of New York and Indiana, announced that Model GT-25 terratrac crawler tractors are now coming off the assembly lines at their new plant in Churubusco, Indiana. Units are amply powered by a 4 cyl, Continental Red Seal Industrial gasoline engine, which provides over 20 drawbar hp and 25 belt hp. Pull in first gear exceeds 3000 lb.

(9) Precision Photometer

The Macbeth Corporation, Newburgh, New York, takes pleasure in announcing the new Macbeth-Ansco color densitometer, an ultra-sensitive precision photometer with a wide range of diversified uses in many industries. This instrument permits ac-



curate measurement of color densities in narrow spectral ranges, as well as visual densities over an unusually wide range, the manufacturer states.

(10) Corrosion Preventive

Pipe wrap is used in a new method to prevent corrosion in storage tanks containing crude petroleum. Developed by the Industrial Service Company, Cushing, Oklahoma. The company states a savings of $1500 per tank, plus the cost of 50 tons of steel by use of the Coromat, is possible. In the storage of crude petroleum, a tank maintenance problem occurs because of impurities present in the unrefined oil. These impurities include water and sulfur products which settle to the bottoms and lower sides of the tanks and cause corrosion.

(11) Packless Pump

The problem of finding a packless pump free of contamination and corrosion resistant, to transfer liquified petroleum gas at pressures ranging from 100 to 200 psig, was solved by Esso Laboratories, Research Division, Linden, New Jersey by the recent installation of the new Vanton non-corrosive "flex-i-liner" pump. It is ideally adapted for handling contaminating liquids such a acids, alkalies, etc.

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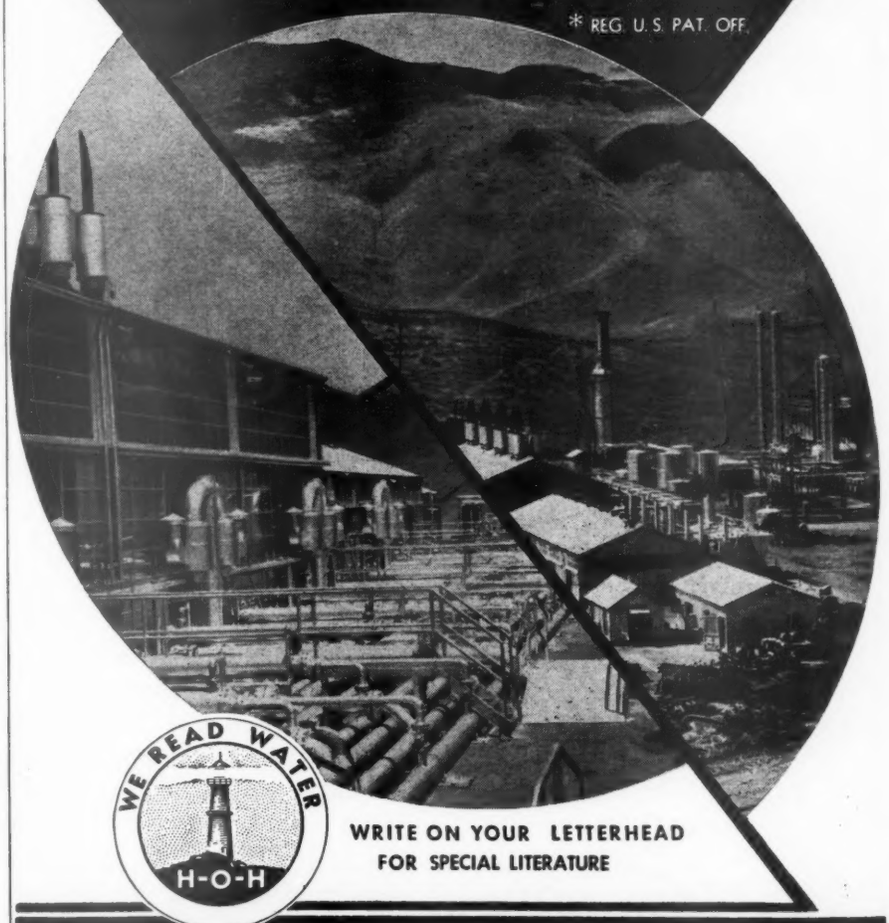

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(12) Fire Extinguishers

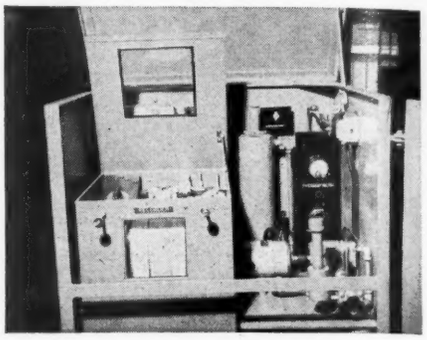
American-LaFrance-Foamite Corporation of Elmira, New York, has completed a new line of 2½-gal fire extinguishers. The new models include a chemical foamite unit for class A and B fires, a chemical solution for class A fires, and a plain water type, discharged by carbon dioxide gas, also for class A fires. The manufacturer claims the new extinguishers are twice as strong as the old style copper units and about 50 per cent lighter in weight. All of the extinguishers are welded construction, elbow and collar silver brazed.

(13) Measuring Mud Flow

To help drillers guard against well blowouts, a new system of measuring changes in the mud flow cycle during drilling operations has been announced by Shand and Jurs Company of Berkeley, California. The new S&J mud flow measuring system has been designed to give the maximum in accuracy, dependability and long life, it was stated. This new S&J system consists of 4 separate units; 2 measuring and 2 indicating or recording instruments. One measuring unit, the mud pit level gage, is placed in the mud pit near the suction intake.

(14) Formation Logger

A new formation logger has been announced by the Petroleum Instrument Company of Houston, Texas. This unit permits the drilling operator or geologist to obtain a constant recording of the rate-of-bit-penetration, thus identifying drilling breaks. The gas detector records the presence, or absence of hydrocarbons in these formations. The instrument may also



be used as a warning device in detecting the existence of dangerous gas-cut mud. The drilling rate portion of the unit embodies an electrical circuit that records the interval required to drill 2 ft. The gas intensity system involves the usual Wheatstone Bridge and detector filament.

(15) Yard Crane

A new 12½-ton truck-mounted industrial yard crane has been announced by the Wayne crane division of the American Steel Dredge Company, Fort Wayne, Indiana. This new machine, known as the Model 40, supplements the line of heavy-duty crawler-and-wheel-mounted industrial yard cranes manufactured by Wayne Crane. The new truck crane has an increased swing speed to 6.4 rpm and travels at truck speeds—converts easily to all crane and shovel attach-

ments. The heavy-duty carrier is engineered and built especially for crane service. Husky, wide-flanged, deep-section I-beam frames provide a solid crane base. Equalizing beam-type suspension and a locking third differential make possible off-the-road work.

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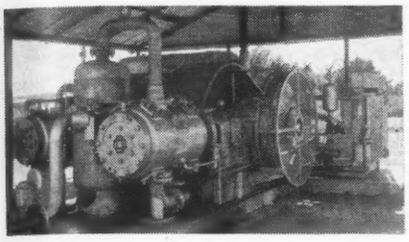
(16) Gas Booster Unit

The Knight Manufacturing and Supply Company, Tulsa, Oklahoma, announces the Knight gas booster unit consisting of Gardner-Denver compressors and suitable power units, available in sizes from 5 to 300 Compression hp. These skid-mounted units are designed for either outside or in-



side installation. Although they are portable and can be quickly installed, they have the capacity and performance of a permanent installation. They are easy to disconnect and move and are compactly built to road limits. Replacement parts are readily available.

(17) Unbreakable Buckets

Unbreakable buckets for carrying corrosive chemicals have been developed by the mechanical goods division, United States Rubber Company, New York City. Made of Enrup, a tough new thermosetting blend of plastic and rubber, the buckets are now being produced in quantity at the company's Passaic, New Jersey, plant. They are lighter and tougher than hard rubber varieties, and will not crack or shatter under severe abuse, it is claimed. They will resist aliphatic solvents, all concentrations and types of alkalies, most acids and other corrosives up to temperatures of 150 F. They are not designed for carrying formic, glacial acetic, or concentrated nitric and sulfuric acids, however, nitric and sulfuric acids in concentrations up to 50 per cent can be handled satisfactorily.

(18) Small Valves

The Wm. Powell Company, Cincinnati, Ohio announces a new line of small size, high pressure, cast steel valves designed for such services as high pressure steam, boiler feedwater, by-pass, instrument and throttling. Known as Powell Integral Bonnet Valves, they are available in globe, angle and "Y" patterns, classes 1500 and 2500 lb, in sizes ½ in. to 2 in., inclusive, and have socket weld ends. The manufacturer states that one of the outstanding features is the one-piece construction of the body and bonnet, which eliminates the body bonnet joint and all possibility of leakage at this point.

(19) Gas Detector

Petroleum Instrument Company, Houston, Texas, has announced development of a portable formation gas detector, which, it claims, will assist the geologist or drilling personnel in checking for the presence of formation gas in cuttings, cores, and mud from the flow line. The unit is composed of a high-powered, motor-driven stirring device and a small cabinet that contains the indicating meter and other electrical devices. The entire instrument is contained in a carrying case about 30 by 18 by 12 in. and weighs 75 lb.

(20) Sealing Compound

A new sealing compound for threaded joints and gasket surfaces known as Leak Lock has been introduced by the Highside Chemicals Company, Clifton, New Jersey. Leak Lock sets up approximately three times faster than other joint sealing compounds that do not become hard or brittle. This prevents liquids and gases from pushing through the compound before it has set up. Leak Lock remains plastic enough to permit easy disassembly. Leak Lock forms an elastic, rubbery film that will flex with vibrations and retain a smooth skin.

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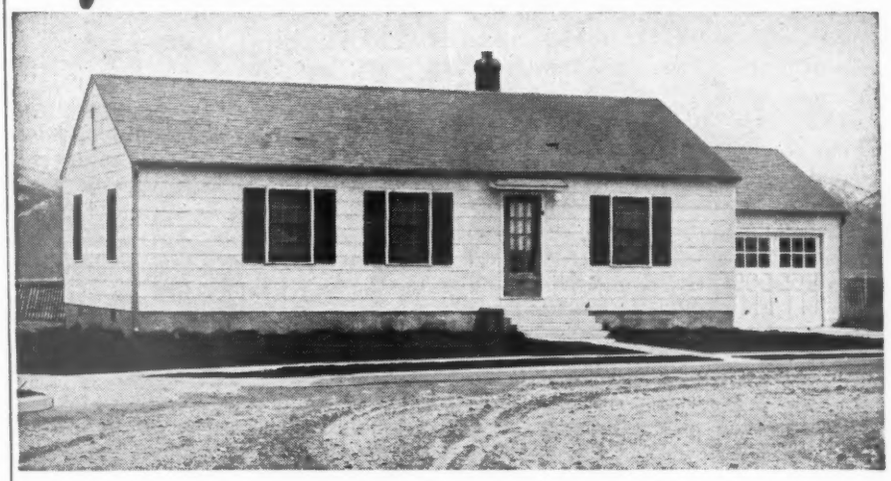

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Trade Literature

Publications will be sent free. Circle the number on the coupon.

(21) Packaged Chains

Morse Chain Company, Detroit 8, Michigan, has published Folder F 57-50, which gives a complete description of all Morse factory-packaged chains and parts together with list prices. This is the first complete packaging program in the industry, according to the company.

(22) Consolidated Rig

The new Ideal Type 50-A consolidated rig, a redesign of the Ideal Type 50, for shallow to medium drilling, is featured in Bulletin 366, a 16-page bulletin published by National Supply Company, Toledo, Ohio. This new bulletin emphasizes general air operation of the rig, increased diameter of the main hoisting drum, and unitized "narrow type" chain compound drive group constructed integrally with extended draw works skids. Principal units are separately illustrated and described, including drum shaft and transmission assemblies, drum shaft brakes, rotary drive countershaft, and controls. The bulletin also tabulates engineering and operating specifications, gives shaft speed diagram, and dimensional drawing.

(23) Industrial Thermocouples

Thermo Electric Company, Inc. of Fair Lawn, New Jersey has just published a new catalog section describing and illustrating its industrial thermocouples. The company claims that its standard industrial thermocouples, assemblies, and parts cover most applications encountered in industry. This particular section illustrates the standard models. Information concerning special designs or types of thermocouples other than those shown in the bulletin will be sent upon request.

The catalog is divided into 6 sections showing illustrations and offering much reading material on tubular thermocouples, and protection tube assemblies; wire type protected thermocouple assemblies; thermocouples for plastic molding, permanent molds, power plants, chemical plants, oil refineries; portable pouring thermocouples for molten metals, protection tubes and accessories, connection; connection heads and quick coupling connectors.

(24) Control Valves

A new bulletin describing the K & M Series 1200 and 1400 diaphragm control valves has just been issued by Kieley and Mueller, North Bergen, New Jersey. The diaphragm motor embodies the accessibility and other features of the "open yoke," formerly available only in cast iron construction, together with the strength and resistance to shock found only in steel. The boltless casing assembly is constructed with an exclusive clamping ring, which permits ready inspection and reassembly. Valve bodies are made with flow passages having a minimum average area of 140 per cent of comparable size pipe area, and inner valve open free areas average 80 per cent of pipe area.

(25) Logging Instruments

A complete line of electric logging instruments has been made available by Well Instrument Developing Company, Houston, Texas. Engineered and designed to solve specific problems encountered in various types of exploration, these instruments are completely described and illustrated in Bulletin EL-17.

(26) Centrifugal Pumps

Pumping units for every industry are catalogued in a new 16-page "Handy Guide to Selection of Centrifugal Pumps released by Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin. A wide variety of units are indexed in this bulletin including close-coupled, pedestal, double suction, single stage, multi-stage, self-priming, fractional horsepower, coolant and circulating, fire, process, solids handling, marine, rubber-lined, paper pulp, sewage, axial, and mixed flow pumps. Head capacity charts and tables for various types of the pumps are given along with data on sizes, capacities and construction features.

(27) Thermocouples

Arklay S. Richards Company, Inc., Newton Highlands, Massachusetts, has announced that its new bulletin on thermocouples is now available. The fully-illustrated bulletin contains diagrams and information on thermocouples, protection tubes, thermocouple wire, lead wires, insulators for all makes of pyromethers. It gives directions for ordering with catalog numbers, and recommended applications.

(28) Differential Pressure Cell

A technical report on "Savings Effected at Goodyear Synthetic Rubber Corporation through Control of Latex Flow by Differential Pressure Cell" will be of interest to all those whose plant operations involve the measurement of flow of viscous or corrosive fluids. The report, which is based on experience in the Goodyear plant at Torrance, California, cites three important and specific advantages gained when the cell was installed on the latex line to the blend tanks, instead of a conventional mercury manometer-type meter. Loss of production time due to instrument trouble was virtually eliminated; manhours required for maintenance were reduced from six per week to one per week; and estimated savings, resulting from these two benefits gained, were sufficient to pay for the complete instrumentation in approximately one year.

(29) Steel Derricks

A complete line of steel derricks with capacities of up to 250 tons, is shown in American Hoist and Derrick Company, St. Paul, Minnesota's new 36-page Catalog, No. 200-D-3. The 6 different types of derricks are treated separately in sections that include complete specifications, outline drawings, and full page operating pictures. Following these sections are complete construction details from boom points to sill connections.

One page is devoted to the correct method of determining boom length for lifting a required load to a predetermined height at a given radius. Briefly covered are lifting beams, swiveling fairleaders, blocks and sheaves, as well as revolver cranes and hoists.

(30) Rust Prevention

The story of industrial rust prevention is thoroughly covered in Rust-Oleum Corporation, Evanston, Illinois' latest bulletin. Directions that are easily understood relate to uses under general exposure and other special conditions which produce rust, for machinery and implement finishes, heat-resistant and chemical-resistant coatings, floor coatings, etc., and include different kinds of service and application. One of the most important advantages of the new catalog is the extensive showing of color chips. There are at least 70 colors plainly designated and reproduced. The specification descriptions are complete, clearly indicating resistant qualities, drying time, thinner requirements, and methods of application.

(31) Steam Unit

A bulletin on a new steam generating unit completely shop-assembled for unit shipment, is announced by The Babcock and Wilcox Company, New York City. The 12-page brochure describes this B&W integral - furnace boiler, Type FM, and many of its installation and operation advantages. Pictures and diagrams illustrate the method of gas flow through the unit, soot blower arrangement, furnace and boiler wall construction, and the packaged control cabinet. Capacities, dimensions, and shipping weights of the standard sizes are included in the bulletin, known as G-72.

(32) Sucker Rods

National sucker rods for every field condition are described and illustrated in color in a new 16-page bulletin, No. 368, published by National Supply Company, Toledo, Ohio. The bulletin covers three grades of sucker rods each recommended for certain load and corrosive conditions. It also includes specifications for hollow sucker rod couplings, pony rods, polished rods, and pull rods. Manufacturing methods, metallurgical control, handling care, and field stocks are profusely illustrated. Sucker rod specifications are given for 4 sizes from $\frac{5}{8}$ to 1-in. diameter in lengths of 25 or 30 ft.

(33) Strainers, Separators

American District Steam Company, North Tonawanda, New York, has recently published a bulletin No.4-46-50A, which is a revised 16-page catalog of Y- and T-type strainers, suction strainers, multi-flow separators, and receiver-separators. It contains descriptions, dimensions, weights, and list prices of the entire line. Several types have been completely redesigned for increased efficiency and the range of sizes has been increased. Included in the bulletin is technical data to aid in selecting proper type and capacity. Engineering information on flange dimensions and service pressure ratings is included.

(34) Reference Guide

Dow Corning Corporation, Midland, Michigan, has available a 4-page flyer entitled "A Reference Guide to Dow Corning Silicone Products." Divided into six sections, it describes and gives much technical data on its fluids, compounds, greases, resins and varnishes, silastic, and silicon chemicals. More detailed data may be ordered from the company, as the reference guide serves to acquaint the public with the type of products produced by Dow Corning.

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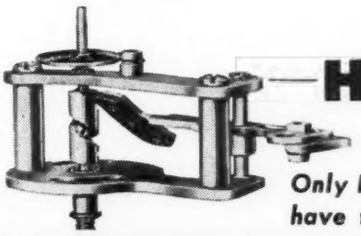

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(35) Insulation Data

A new 36-page booklet entitled "PC Foamglas, The Long Life Insulation for Commercial, Industrial, and Public Buildings" has just been released by the Pittsburgh Corning Corporation, Pittsburgh, Pennsylvania. A single piece of literature contains the complete story on normal temperature (50 to 150 F) applications of PC Foamglas. Included in the booklet is new information concerning the installation of Foamglas in floors-on-ground; the use of the material as a wall lining, for erecting free-standing interior walls, and for ceiling insulation. Also, contained is technical data, facts about PC accessory materials, and a description of the new line of trowel finishes that can be applied directly to PC Foamglas.

(36) Pipe Cutter

New literature of interest to plumbing and heating contractors, electrical contractors, maintenance men, and users of pipe tools is announced by Beaver Pipe Tools, Inc., Warren, Ohio, with its 4-page flyer on the Beaver 102-PD (power drive) pipe cutter. Also described in this new folder is the Beaver No. 77 threader, an adjustable, ½ to 2 in. pipe threader, to use with electric power drives.

(37) Packer Service

Lane Wells Company of Los Angeles, California, has available a 4-page bulletin describing its engineered packer service. This service, according to the bulletin, analyzes well conditions and operations, both present and projected, and applies latest engineering techniques to all the factors involved in order to give the operator answers to packer problems, or detailed programs for packer applications and operations. The 101 Lane Wells field men provide engineered packer service for any operator on request. Engineered packer service is available to every major oil-producing area in the U. S.

(38) Line Tubing

"Instrument Lines of Alcoa Aluminum" is the title of Aluminum Company of America's latest bulletin. The company, situated in Pittsburgh, Pennsylvania, published this 8-page bulletin to give a clearer conception of the features of aluminum instrument line tubing. It states that ALCOA tube is seamless — smooth inside and out. It weighs about one-third as much per foot, size for size, as other commonly used metal tubing. ALCOA tubing may be bent by hand in the field to fit it properly into required locations.

(39) Metal Hose

All types of industrial metal hose, tubing and fittings for conveying solids, fluids or gases at elevated pressures and temperatures are described and illustrated in the new 12-page No. U-101 catalog recently issued by Universal Metal Hose Company of Chicago, Illinois. Typical applications for each hose classification are listed. Specifications are complete and organized for easy reference. Cross-section photos give close-ups of construction detail. Covered in the catalog are Universal square-locked flexible tubing, interlocked flexible hose, seamless flexible hose, diesel engine exhaust hose, hose assemblies, and couplings.

(40) Rubber Putty

A new catalog section on its Plastikon rubber putty has been published by The B. F. Goodrich Company, Akron, Ohio. The section cites the advantages of the product, gives directions for use, and lists stock colors and grades. Special grades are available for unusual services. Among uses for which the product is recommended are for glazing in greenhouses, railroad cars, trucks and buses, boats and ships, showcases, refrigeration units and aquariums, for sealing window frames, tile roofs, joints in stone cornices at top of brick walls, between enameled metal tile, stopping leaks in plumbing joints, and for setting toilet bowls, showers and built-in bath tubs.

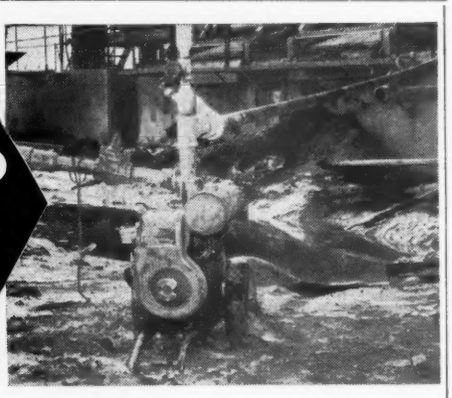
(41) Sludge Contact

Cochrane Corporation, Philadelphia, Pennsylvania has just published a two color, 16-page bulletin on its sludge contact reactors. In the new sludge contact reactor, states the manufacturer, previously formed precipitates are kept suspended rather than allowed to settle out. The sludge is present at the point where raw water and chemicals are thoroughly mixed and this sludge forms a nucleus on which the newly formed precipitates plate out and grow. The sludge contact process is diagrammed and thoroughly explained. Two types of reactors are clearly drawn to show the intricate workings — the round and the rectangular type.

(42) Tubing Spider

National Type "B" tubing spider and slip assembly, designed to accommodate all sizes of tubing in two sizes of assemblies, is fully described with illustrations in a new 4-page bulletin, No. 367, published by The National Supply Company, Toledo, Ohio. Catalogs are free on request.

This Pump Works HUB DEEP IN MUD It's WISCONSIN-Powered!



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Books you may want

Chemical Engineering Cost Estimation, *by Robert S. Aries and Robert D. Newton, published by Chemononics, Inc., 400 Madison Avenue, New York 17, N. Y. Pages, 109. Price, $5.00.*

This handbook allows estimating of equipment by graphical methods for all pieces of major equipment, piping, insulating, and other auxiliaries. The book consists of several tables and graphs for rapid cost estimation, it is offset printed in 8½ by 11 file size.

Procedure Handbook of Arc Welding Design and Practice, *published by The Lincoln Electric Company, Cleveland 1, Ohio. Pages, 1200. Price, $2.*

In a new 9th edition, the handbook has been reorganized and re-edited to bring information up to date and include recent important welding developments. Recognized as an authoritative source of information on arc welding design and practice it consists of 1300 photographs and drawings. A completely new chapter has been added to the handbook on welded design data. This chapter presents the fundamentals of welded design for both machinery and structures. It gives fundamentals that can be applied to particular design problems.

Engineering Economy, *by H. G. Theusen, published by Prentice-Hall, Inc., 70 Fifth Avenue, New York, New York. Price, $6.65.*

Engineering Economy is an up-to-date study of the methods for determining the comparative costs of alternative engineering methods. The book treats every phase of achieving economical production in all branches of engineering.

Equivalent Valves, *compiled by H. Gordon Hawes, published by Hooper Publishing Company, 545 Sansome Street, San Francisco 11, California. Price, $15. 1950.*

A manual of equivalent valves of the 18 leading valve manufactures has been compiled by a graduate of Massachusetts Institute of Technology. Of interest to specifiers, buyers, and users of valves it contains 175 pages of data, which have been checked by each of the manufacturers. It serves as a guide as to the differences between the valves for a given type, material, and pressure rating; one may determine which valves are equal or equivalent.

Chemical Thermodynamics, *by Frederick D. Rossini, published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Pages, 514. Price, $6.*

This book is a study of chemical thermodynamics from the fundamental laws to the application of these laws to real physical and chemical systems. The first part of the book explains background material, such as the status of the scale of temperature, the fundamental constants, and the calorie and joule. The last part deals with special applications, illustrative calculations, and sources of chemical thermodynamic data.

Black Bonanza, *by Frank J. Taylor and Earl M. Welty, published by McGraw Hill Book Company, Inc., 330 West 42nd Street, New York 18, N. Y. Pages, 280. Price, $4.*

An historical narrative of oil in the West, *Black Bonanza* is a study made by the Union Oil Company of California. This is the story of how Lyman Stewart, and other pioneers of Pennsylvania's petroleum boom fought for markets and production. It begins two decades before the first well was drilled in Pennsylvania and carries through to the present and is a story of the founding of the Union Oil Company.

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Crude Oils Chemical and Physical Properties. *General Editors Dr. Benjamin T. Brooks and Dr. A. E. Dunstan; Oxford University Press, 114 Fifth Avenue, New York 11, N. Y. Price, $11. Pages, 200. Volume 5, 1950.*

This book, the first part of Volume V, deals with the chemistry, physics, and chemical engineering of petroleum. It is a study of the principles and practice of the production, refining, transport, and distribution of mineral oil. The purpose is to serve a record of the past 12 years of technological advances of petroleum technology.

When the Oil Wells Run Dry, *by Walter M. Fuchs, Industrial Research Service, Dover, New Hampshire. Pages, 430. Price, $5.50.*

The story of oil—its past, its present, and its future. Recommended by the Book-of-the-Month Club, and the Scientific Book Club it is written by author, teacher, scientist, industrialist, inventor, and research and consulting chemist Dr. Walter M. Fuchs.

Questions of vital importance to everyone are answered. In words that everyone can understand the author tells how oil can be converted into rubber, alcohol, and other products that formerly were obtained only from plant and animal life.

Crude Oil in Germany, *by Dr. H. Hassmann, published by von Hernhaussen KG. Hamburg 36, Germany. Pages, 94. Price, DM 3,20.*

In 6 chapters the book deals with the location of crude oil deposits, the technical side of crude oil production and refining, the history, the regions, and the importance and problems of the German crude oil production. Numerous tables, maps, illustrations and bibliographical data supplement the text and cite the further prospects of the German crude oil industry. The book is written in German.

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